ENVIRONMENTAL ASSESSMENT BOARD

Ontario

ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARINGS

VOLUME: 140

DATE: Thursday, April 30, 1992

BEFORE:

HON. MR. JUSTICE E. SAUNDERS	Chairman
DR. G. CONNELL	Member
MS. G. PATTERSON	Member

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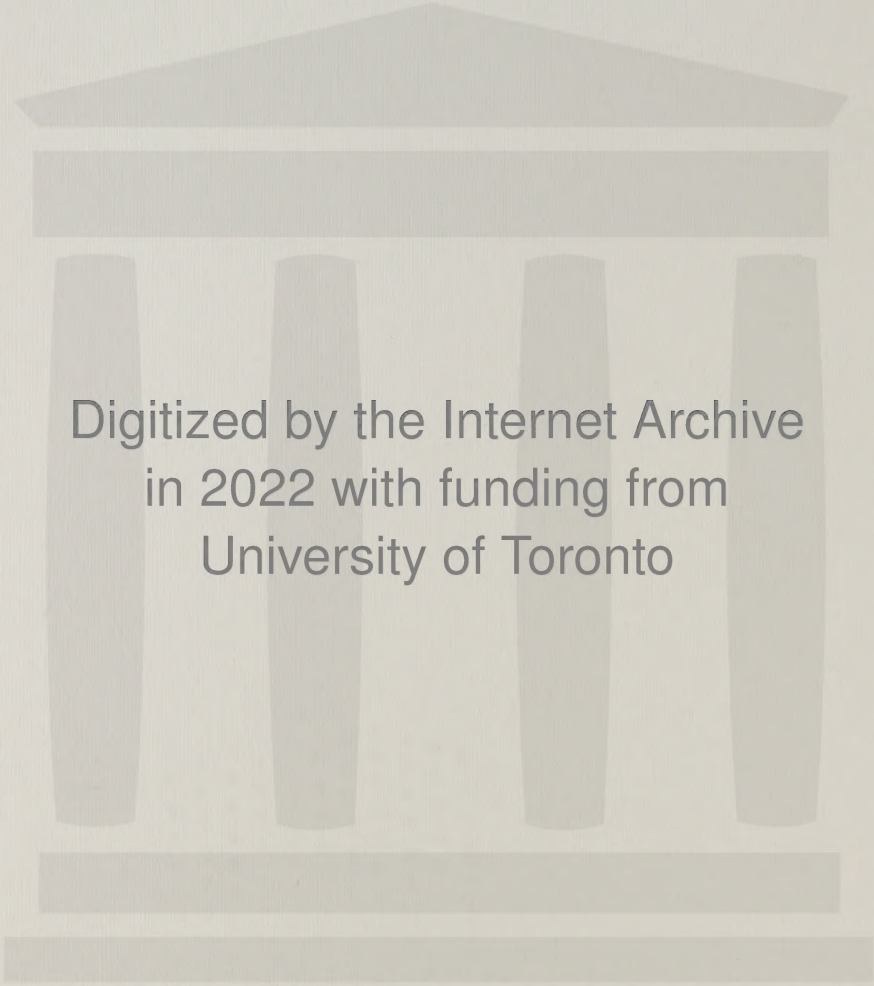

ENVIRONMENTAL ASSESSMENT BOARD
ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARING

IN THE MATTER OF the Environmental Assessment Act, R.S.O. 1980, c. 140, as amended, and Regulations thereunder;

AND IN THE MATTER OF an undertaking by Ontario Hydro consisting of a program in respect of activities associated with meeting future electricity requirements in Ontario.

Held on the 5th Floor, 2200 Yonge Street, Toronto, Ontario, Thursday, the 30th day of April, 1992, commencing at 10:00 a.m.

VOLUME 140

B E F O R E :

THE HON. MR. JUSTICE E. SAUNDERS	Chairman
DR. G. CONNELL	Member
MS. G. PATTERSON	Member

S T A F F :

MR. M. HARPUR	Board Counsel
MR. R. NUNN	Counsel/Manager, Information Systems
MS. C. MARTIN	Administrative Coordinator
MS. G. MORRISON	Executive Coordinator

A P P E A R A N C E S

B. CAMPBELL) L. FORMUSA) B. HARVIE) J.F. HOWARD, Q.C.) J. LANE) G. A. KARISH)	ONTARIO HYDRO
J.C. SHEPHERD) I. MONDROW) J. PASSMORE)	IPPSO
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M. MATTSON) T. McCLENAGHAN)	ENERGY PROBE
A. WAFFLE	ENVIRONMENT CANADA
M. CAMPBELL) M. IZZARD)	ONTARIO PUBLIC HEALTH ASSOCIATION, INTERNATIONAL INSTITUTE OF CONCERN FOR PUBLIC HEALTH
G. GRENVILLE-WOOD	SESCI

APPEARANCES
(Cont'd)

D. ROGERS	ONGA
H. POCH) J. PARKINSON)	CITY OF TORONTO
R. POWER	CITY OF TORONTO, SOUTH BRUCE ECONOMIC CORP.
S. THOMPSON	ONTARIO FEDERATION OF AGRICULTURE
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D. HUNTER) M. BADER)	DOFASCO
B. TAYLOR) D. HORNER) H. WATSON)	MOOSONEE DEVELOPMENT AREA BOARD AND CHAMBER OF COMMERCE

A P P E A R A N C E S
(Cont'd)

T. HEINTZMAN D. HAMER C. FINDLAY	)))	ATOMIC ENERGY OF CANADA
P.A. NYKANEN	)	CANADIAN MANUFACTURERS ASSOCIATION - ONTARIO
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D. COLBORNE		NIPIGON ABORIGINAL PEOPLES' ALLIANCE
R. CUYLER		ON HIS OWN BEHALF
L. BULLOCK L. CHAN	))	CANADIAN NUCLEAR ASSOCIATION

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L I S T o f E X H I B I T S

L I S T o f U N D E R T A K I N G S

TIME NOTATIONS

---Upon commencing at 10:03 a.m.

THE REGISTRAR: Please come to order. This hearing is now in session. Be seated, please.

THE CHAIRMAN: We want to put an exhibit on file, on the record, the document has been received by the Panel entitled: Final Guidelines for the Preparation of an Environmental Impact Statement on the Nuclear Fuel Waste Management and Disposal Concept. This document is dated March 1992, and is issued by the Federal Environmental Assessment Review Panel.

MR. D. POCH: Might that be given an exhibit so it will get on our list?

THE CHAIRMAN: It is supposed to have a number.

THE REGISTRAR: 651.

MR. D. POCH: I appreciate that.

THE CHAIRMAN: 651.

---EXHIBIT NO. 651: Final Guidelines for the Preparation of an Environmental Impact Statement on the Nuclear Fuel Waste Management and Disposal Concept, dated March 1992, issued by the Federal Environmental Assessment Review Panel.

THE CHAIRMAN: Mr. Mondrow?

MR. MONDROW: Good morning, Mr. Chairman.

DAVID WHILLANS,
KURT JOHANSEN,
FRANK CALVIN KING,
WILLIAM JOHN PENN,
IAN NICHOL DALY; Resumed.

CROSS-EXAMINATION BY MR. MONDROW (Cont'd):

Q. Good morning witnesses.

Mr. Daly, could you please turn up the transcript from last date, that would be Volume 139.

MR. DALY: A. Yes I have, 139.

Q. I think we will just wait a minute, sir, if we could.

A. Sure.

THE CHAIRMAN: Could you give me the page number, please?

MR. MONDROW: Certainly, sir. It's 24507.

THE CHAIRMAN: You can go ahead, Mr. Mondrow, we have got it.

MR. MONDROW: Q. Mr. Daly, we were talking there about common mode failure projections in Exhibit 148C and I asked you at line 2, does this analysis include any of the accident scenarios that you have done. If we skip down to line 9, I think you started your reply there to that question, and you said:

"I think most of the accidents

postulated would normally be expected to happen on one unit at time. So any contribution from a common mode accident I would expect to be pretty small."

I would like to refer you back to transcript Volume 136, please, on page 23948.

MR. DALY: A. Yes, I have that.

Q. And starting at line 7 on that page in response to a question from Dr. Connell, Mr. King was talking about the Darlington probabilistic safety, I thought it would have been analysis - evaluation, I'm sorry, I had forgotten the acronym - which is Exhibit 520.18 and then down at line 12 he references a fuel damage category 9 event. The reservoir for coolant which is injected in such an event, Mr. King, is shared between all units at Darlington; is that correct?

MR. KING: A. The tank used in the high pressure part of the injection is a shared tank.

Q. So if one reactor trips that tank system. All four units shut down; is that correct?

A. If you have a loss of coolant accident which requires the high pressure injection, then procedures are, over some period of time you would have to shut down the remaining units until you recommissioned the emergency coolant inject system, the

high pressure part of it, to be available for the other units.

Q. In fact, if you turn over, please, to page 23950 at line 12, I will read to you your testimony, Mr. King.

"What we assume in this particular case is that we have four units, all four Darlington units down for four months, because this, the emergency coolant injection system is a common system to the four units."

So we see that if that system is tripped, all four units go down, and you assume that they will be down for four months; that's correct?

A. That was the assumption in the DPSE study. That four month time frame that was assumed in the study does not necessarily depend on the time required to recommission the high pressure side of the emergency coolant injection, but it may well associated, depending on what caused the accident in the first place, investigations that may have to be undertaken to ensure that the other units aren't vulnerable to the same sort of scenario.

So those investigations combined with the recommissioning we have assumed for the purpose of that

study would be a period of four months.

Q. Okay. If you just flip back one page to 23949, you give of the frequency for that the postulated event starting at line 8. You say:

"The frequency for that category, that fuel damage category 9 which we are talking about was estimated to be 2.3 times 10 to the minus 2 occurrences per reactor year of operation."

Expressed another way then this incident would occur 2.3 per cent of reactor years; is that correct?

A. Well, the units are per reactor year, the frequency of the occurrence is 2.3 within 100 reactor years.

Q. Okay.

A. I also gave testimony which suggested that the way we derived that frequency, which was based on zero occurrences of that event occurring within 100 reactor years of operation, since we have made that estimate we have almost doubled our reactors years of operation, so if we were doing an estimate today, it would be less than the number which I quoted here and which is in the DPSE study.

Q. But this number that you have quoted

here would have been of the number that were assuming when Exhibit 148C was published, we were looking at 148C last day, that's the common mode table at page 30 of that exhibit. This isn't the number you have been have been using when those numbers were put out?

A. I am not familiar with how 148C was derived at all.

Q. Let's just continue with this number for a minute, if we could.

If we multiply 2.3 per cent by the four month duration that you spoke of, which is a third of the year, we get a third of 2.3 per cent, which is a .77 per cent probability of occurrence.

Can you confirm that based on these numbers that you testified to?

A. I'm not exactly following what you are trying to calculate.

Q. Frequency times duration.

A. 2.3 per cent frequency.

A. We don't normally express frequency like that at all. It's per reactor year of operation.

Q. Okay, we will express it in the terms you expressed it in, Mr. King. We have 2.3 times 10 to the minus 2 per cent frequency; is that right? I'm sorry, occurrences per reactor year?

A. That's right.

Q. When you have an occurrence this takes a third of a year, your estimates, to put the units back on line?

A. That's what the assumption in the study was.

Q. When you multiply the frequency by the duration we get .77; is that right?

THE CHAIRMAN: What are you multiplying to get .77, what by what? Give me the figures, please.

MR. MONDROW: 2.3 divided by one-third, Mr. Chairman.

THE CHAIRMAN: By one-third.

DR. CONNELL: Multiplied by a third?

MR. MONDROW: Sorry, 2.3 multiplied by a third. It's 2.3 times four months, which is a third of a year which is .77 per cent. That's 7.7 days out of 1,000, Mr. King.

THE CHAIRMAN: Just a minute. If we just get this first.

Are you with them, Mr. King, on this on the, 2.3 times a third?

MR. KING: Well, I see where he gets his .77, I am not sure what that reflects.

MR. MONDROW: Q. It's.77 per cent.

It's 7.7 days out of 1,000 that this outage will occur in your probability estimate; is that right?

MR. KING: A. We are saying this event would occur once every -- we want to round it off to 2 instead of 2.3. It would occur once every 50 years. Two times 10 to the minus 2 is one in 50 years. So you are saying 1 in every 50 years.

[10:13 a.m.]

Q. That's the frequency. And the duration?

A. You could be out for four months.

Q. Which is a third of a year.

A. That's right.

Q. So the frequency times the duration?

A. Okay.

THE CHAIRMAN: It might be easier to grasp the point if you thought of a reactor operating for 1,000 years and in 23 of those years you might expect a failure. And if on each occasion it was out four months, I guess that's right, it would total 7.7 years out of 1,000.

MR. MONDROW: That's right, Dr. Connell. Or the way I tried to phrase it, which is analogous, is 7.7 days out of 1,000 days.

Q. Mr. King, can you confirm that?

MR. KING: A. I have .8 per cent. Is that what you have?

Q. That's fine. So that would be eight days out of 1,000?

A. Yes.

Q. And if you turn up our Exhibit 647, please, to page 6. This is the transcript undertaking from Panel 2. It's Exhibit 142.5.

THE CHAIRMAN: Just hold it, please.

MR. MONDROW: Q. And this is where --

THE CHAIRMAN: Just a minute.

MR. MONDROW: I'm sorry, sir.

THE CHAIRMAN: Now, you can go.

MR. MONDROW: Thank, Mr. Chairman.

Q. This is where Ontario Hydro has calculated through the numbers from Exhibit 148C to give us the frequency and duration products. So we see that the eight days out of 1,000 is a lot larger than any one of these numbers on this page.

So, Mr. Daly, my point is that if you did include accidents in your common mode numbers, that number would have to be significantly higher, wouldn't it?

MR. DALY: A. It would appear so from the calculation we have just gone through. When I

testified yesterday, I believe I mentioned that operations had looked at this, and most of my experience was reflecting the operations experience. We looked at our operating experience of common mode-type failures.

I was aware that design also looked at this and I was aware that they had looked at whether accidents should or should not be included. And they had, I know, had some discussions. And when that came together with system planning, they ended up for their purposes quoting the figures in the reliability report.

I think since accidents are addressed within Hydro's documentation, it's not as if accidents are not addressed. They are clearly addressed. And Mr. King has pointed you to some places where they are addressed. And I think there is some argument that, you know, accidents are a particular type of event that we have to deal with. But so also are the instantaneous type of non-accident common cause failures. There was a undertaking following our discussion yesterday, and that was one of the points we did intend to clarify in the undertaking.

Q. So the numbers that we can expect in response to that undertaking, then, will include accident figures?

A. I think I would want to run that past system planning. Because really, the numbers are there for their purposes in planning the system.

Hydro's accidents figures are on the record and system planning are aware of them. I would want to check with system planning as to whether they felt it was appropriate to put them into that particular figure for the purposes that they intended to use it.

Q. We can come back to question, then, in Panel 10, Mr. Daly. Perhaps that would be appropriate. But you would agree that if accidents were included these numbers would have to be significantly raised.

A. They would certainly have to be raised. I think, obviously, we would have to look little closer at the numbers to confirm just by how much.

Q. Thank you.

MR. KING: A. If I could just one more thing.

Q. Please.

A. This calculation in Exhibit 142.55, I take it, was done in mid-August, 16th, 1991. I did not have any input into this calculation. The first time I

saw it was, I guess, a few days ago when you brought it up.

But if I had been asked in August 16th, 1991, to input to it, I would not have put in the number from the DPSE, which was an estimate based on that 100 reactor years of experience in 1985. I would have brought in the experience up to that date, and the number would have been a fair amount below the eight in 1,000 number that we derived a few minutes ago.

Q. Whatever that number is, though, it would have been in addition to the numbers in fact included in Exhibit 148C, is that correct? You don't include any number for accidents in Exhibit 148C, or in these numbers on a similar undertaking. I think Mr. Daly testified to that.

A. Well, I'm not exactly sure what is in the 142.5.

Q. Well, we have got an undertaking, and when we get to the response to that maybe we will have a better idea what's in there.

MR. PENN: A. I think one of my difficulties, Mr. Mondrow, is that the question isn't posed in your document, so I can't really determine whether the answer fits the question. That's another thing I think we will have to look at.

DR. CONNELL: Is there agreement in the panel, though, that it would be usual practice to include tripping of the high pressure injection system as a common cause failure?

MR. KING: Well, there are certainly ways that you can take down multiple units through accidents. And the more likely one being where we have shared safety systems and you are using them for the accident unit. I don't think there is any doubt about that.

But the confidence in the predictions may be a little -- there's probably more uncertainty in those predictions than in losing multiple units for other non-accident reasons like ice storms, things that we have had before so we have more confidence.

In this case, in the accidents, we are making predictions based on events that we have never had before, so there is more uncertainty in those. And I would assume that perhaps system planning has a little more difficulty with combining the estimates which are based on experience they had in running the system with respect to the more uncertain accident conditions.

MR. MONDROW: Q. Mr. King, has system planning asked you whether those numbers should

appropriately be included, or are you just making an assumption?

MR. KING: A. I guess I'm putting myself in their position. If I was given some accident data based on events that had never occurred based on another set of data which they occur periodically, I would want to have my eyes open when combining those.

Q. But, in fact, they haven't asked you; is that right?

A. I'm not sure exactly where they got these from. I have had no direct communication with planning on this response here.

Q. Thank you.

DR. CONNELL: Perhaps I could just leave it with you, panel, that I thought I had understood what a common cause failure was. But the gist of Mr. Mondrow's questioning has left me somewhat confused, because he seems to putting before you a very broad interpretation. If you have four reactors of similar design, I think some of his questions, have seemed to me to assume that almost anything that goes wrong with one of them could go wrong with the other and could, therefore, be classified as a common mode failure.

[10:25 a.m.]

I previously have been disposed to

interpret it as perhaps some design flaw that was common to all, and because that flaw lead to failure of one reactor it might be expected to lead to a failure of another. That's a much more restricted view of it.

MR. KING: In the reliability engineering field, Dr. Connell, common mode, to me, means failure occurrences which are at the same time which jeopardize the provision of a single goal, a single thing that you want to do. If you have a pumping system and you have two pumps, and you need to provide fluid, then the failure that would cause both of those to fail at the same time when you needed to provide the fluid, that would be a common mode failure.

If they occurred randomly from the same cause at two different points in time, then we would typically not call that a common mode.

In Mr. Mondrow's discussion the last day we were here, when we were looking at multiple units and that, in fact, they had pressure tubes here and they had pressure tubes on another type of reactor, or steam generator tubes here and steam generator tubes there, and hence they were susceptible to common mode, it's not the use of common mode that we would use in reliability engineering.

But there is no doubt that if you have

failures which can bring a unit down, and you have other units with those same design features, there may be implications from one to the other but it's certainly not a given that there would be.

So I was having a wee bit of difficulty with that use of the word common mode, but I will leave it there.

DR. CONNELL: So to make an analogy to cars, if you and I both have cars of different makes and we both have an accident through a brake failure, that's no reason to think that is a common mode failure even if the accidents happened at the same time. Both cars have brakes and they both happen to fail.

If we both have the same kind of car and there is a manufacturing defect and at 10,000 kilometres we both have a brake failure and an accident, then that would be a common mode failure.

MR. KING: In your analogy I would call it a common mode failure.

Most cars these days have dual brake systems. The back brakes or the front brakes are driven by different hydraulic systems. If you have a component in there which somehow is involved with both of your dual braking systems, if that fails causing both of them to fail, then that is a classic common

mode.

DR. CONNELL: Thank you.

MR. MONDROW: Q. Mr. King, if you and Dr. Connell both drove the same kind of car and you each had independent brake failures, would that considered a common mode failure, if it was not simultaneous?

MR. KING: A. I would not consider that a common --

Q. That would be akin to the common problem that I was trying, perhaps unsuccessfully, to distinguish last day with Mr. Daly.

A. Yes. I think that's why I perhaps didn't jump in the other day, because the common problem is probably a better terminology than common mode. And hence you had introduced that terminology.

MR. DALY: A. I think just to add one point. I think when Mr. Taborek was referring at some points to it and discussing certain common problems such as Pickering retubing and the problems at Nanticoke, he was talking of that kind of common problem which is similar at the different stations but is spaced apart in time.

Q. So, Mr. Daly, for example, the steam generators last day we were talking about and you

testified that there had been steam generator concerns worldwide, that would be a common problem?

A. That would be a common problem in most cases.

We have had one or two events where we have had a problem associated a water treatment plant which is common to all units, and we have had a couple of events where a problem associated the water treatment plant did lead simultaneously to problems in a number of steam generators on difference units. So we have had a very small number of common mode problems on the steam generators, but the majority of the problems have been spaced apart in time.

Q. More like common problems rather than common mode?

A. Like common problems rather than common mode.

Q. And the shortages of trained staff would be the same thing then, it would be a common problem rather than a common mode?

A. Yes. With staff it tends to be over a long period of time.

Q. And fueling machines, which is a nuclear specific technology, you have had some problems with your fueling machines more in 1990, and as you

testified, less in 1991 with increased OM&A, but to the extent that you have had fueling machine deratings or outages, that would be another example of common problem with that particular component of the technology?

A. They are normally common problems. There are occasional failures that can affect two or more units. The Pickering fuel transfer system to the fuel bay is common to two units.

The Bruce fuel handling system has some features, a part of the containment feature is common to all four units. However, I think it is fair to say that the bulk of the fueling machine problems would fall in the common problem rather than common mode category.

Q. Vacuum buildings, that would be a classic common mode when you have had to keep your vacuum buildings out for backfits and all four reactors would be kept down, or all eight reactors, I think perhaps at some of your stations, that would be a classic common mode outage?

A. Well, the majority of the vacuum building outages to date have been planned. So we, and the system, have significant advanced warning of the units coming down and the units are taken

out-of-service sequentially. So in the case of a planned outage, it's relatively easy to deal with.

There have been one or two of the common mode type failures where in most cases we were able to correct the failure before the units shut down. But it has the potential to do that first, that's for sure.

Q. And when you plan the outage, we are introducing another term here, but it's a common mode planned outage. You have to take down a vacuum building, you have to necessarily take down all the reactors associated it?

A. To do the vacuum building inspection which we do once every 10 years, yes.

Q. And when you extend an outage, whether it's the deci-annual outage or a more routine out outage to modifications, that would be hopefully planned, possibly unplanned common mode outage?

A. Sorry, which extensions are you talking to?

Q. Well, if you take down the vacuum buildings for inspection and you find that there is an inappropriate amount of leakage, you have to do some modifications, that modification extends the inspection downtime and that would be a common mode outage?

A. Yes. If the vacuum building outage

was forced-extended for any reason, then none of the units would be able to come back into service until the vacuum building was in-service.

In our most recent outage vacuum building outage in Pickering 1990, the vacuum building in that particular case returned to service on schedule and five or six of the units started up immediately. There was couple of problems that led to slight delays in returning the other two units to service.

MR. KING: A. 'Mr. Mondrow, this whole line of questioning where you are introducing these common problems, there is absolutely nothing unique in the nuclear industry, or these problems are not unique to the income industry at all. It's whether you are managing a fleet of aircraft or coal stations or whatever.

Q. Different technologies have different common problems. You don't have vacuum buildings or pressure tubes in fossil stations; you have other kinds of problems.

A. Yes, but they have their own set, and fleets of aircraft have their own set.

Q. And there is no necessary reason why a fossil set of problems has to be the same in terms of cost or frequency or seriousness as a nuclear set of

problems. One technology could present more problems than another technology.

A. You have to look at those features of the multiple common outages, depending on what you are concerned with, whether it's, as Mr. Daly was referring to, in a planned mode, in a planned mode common outages may not be a problem at all.

But you seem to be establishing, through a line of questioning that there are many, many potential common problems, and I am just pointing out that that's equally true for almost every other thing where you have multiples of similar type units or aircraft, or whatever you are that you are talking about.

Q. Okay. Could you turn up, please, our interrogatory package to page 17. In that interrogatory we introduced another term or there was another term that was introduced from Exhibit 74 where the quotation is taken from that talked about generic faults to the nuclear system. If you go to the third paragraph, please, the last sentence, it reads:

> The diversity of equipment provides additional assurance that should a generic problem arise, it would be unlikely to cause the simultaneous

shutdown of all of the nuclear plants.

That's something I have been thinking about throughout your testimony. On the one hand we have had heard, as in this interrogatory, that the nuclear system is diverse, and on the other hand we have heard that advantages have been achieved in the system by standardization and repeating proven systems.

If you could turn up transcript Volume 121, please, Mr. Penn.

THE CHAIRMAN: Is there no question arising out this interrogatory; is that right?

MR. MONDROW: I am going just to put the statement in that interrogatory, Mr. Chairman, about diversity against a transcript reference which I am going to now.

THE CHAIRMAN: Maybe we should put a number on the interrogatory.

MR. MONDROW: Excuse me.

THE REGISTRAR: 520.129.

THE CHAIRMAN: That's 9.14.29.

---EXHIBIT NO. 520.129: Interrogatory No. 9.14.29.

MR. MONDROW: Q. May ask you to turn to Volume 121, please, page 21124.

I'm sorry, I flipped the wrong page. You have to bear with me for one minute.

Page 21124, starting at line 15.

THE CHAIRMAN: Hold it. What is the number of the page, again?

MR. MONDROW: 21124.

THE CHAIRMAN: All right.

MR. MONDROW: Q. Starting at line 15, Mr. Penn, you testified:

"Fifth, the CANDU program has benefited from a fairly high degree of standardization; that is, successive multi-unit stations have repeated design features utilized in earlier stations."

Mr. Penn, is it fair to say from the comment of that transcript excerpt that more is similar between the various nuclear stations than is dissimilar?

MR. PENN: A. Well, that's correct to say that in a conceptually sense, but not necessarily in a detailed engineering sense.

For example, the layout and arrangement of, shall we say, Bruce "B", is generally similar and therefore standardized to that of Bruce "A", with regard to the servicing of the variation reactors with, for example, the fueling machines and fueling trolleys.

Q. Is that what you mean when you said

design features, the layout of the building?

A. Well, the layout of the building is a part of the design. I mean, it's a most important part of the design.

Q. The system configurations, the process systems, they would be similar between the various stations?

A. Their general arrangement might be. For example, the arrangement of the steam generators relative to the reactors is similar, but from one design to another, for example, going from Bruce "A" to Darlington "A", we only have four very large steam generators per reactor in Darlington, whereas we have eight in Bruce "A".

Q. The steam generators themselves are of similar between all the stations, aren't they, the units themselves?

A. Well, they are conceptually similar, but they differ in detail.

Mr. Daly mentioned that one of the reasons we have got a crud-related problem at the broach plates in Bruce "A" is because of the particular arrangement of the broach plates and the clearances with the tubes, whereas in Pickering "A" we don't have that problem at all because of slight differences in

design.

[10:40 a.m.]

Q. Yes, I recognize that you have made changes to the designs.

A. So when we talk about standardization, we are talking about it in a conceptual sense. For example, we say in Ontario we have two standardized designs. Pickering "A" and Pickering "B" is one standardized design, and we have Bruce "A" Bruce "B" Darlington is another standardized design. Because, for example, the second series are square containment, whereas the first series are cylindrical containment.

Q. Repetition of that second series design is, in fact, one of the factors that you cite for keeping costs of the future CANDU "A" should there be one load, is that right? You take credit for that?

A. Yes, but we also take credit for the fact that we have done a great deal of design work on Darlington. We have probably got more documents on Darlington than the rest of the stations put together. And clearly, if we built another station like that, we wouldn't need to repeat all that engineering.

Q. Given that we have diversity in some senses and similarity in some senses, the statement

that we just looked at from that interrogatory that relies on the diversity of the system to assure us that common mode failures are unlikely, should be taken with some caution, would you agree with that?

MR. B. CAMPBELL: I'm sorry. The statement says diversity of the equipment, not diversity of the system.

MR. MONDROW: Q. Would you agree, then, Mr. Penn that the diversity of equipment, that statement, given that some of the equipment is diverse, some of it is similar, should be taken with some caution?

MR. PENN: A. Well, I think I would probably defer commentary on this to Mr. King, because I think what we were talking about here mainly is safety-related matters. When we --

Q. Excuse me. I'm not taking about safety-related matters, Mr. Penn. I'm talking about the costing for a future station.

A. I see. I'm sorry, I didn't understand that.

Q. That's okay.

A. Maybe I should read the sense of this interrogatory, then, a bit more.

Q. We have talked about a lot of common

problems that have nothing to do with safety here. The interrogatory seeks to reassure us that common problems are unlikely, given the diversity of the system. And I took you, Mr. Penn, to a transcript excerpt at which you stated that in fact the program has benefited from a high degree of standardization. My question is, should we not take the statement in the interrogatory with respect to diversity with some caution in light of your testimony?

A. I don't think so. I see this sentence referring to diversity of equipment being, for example, the different manufacturers make relays, for example, that meet the specification that's set down by Ontario Hydro but is produced in a different place, may have different internal design features. And, I mean, they are still relays, but they are diverse.

MR. KING: A. It's my understanding of that last sentence there, I think the whole discussion here in this interrogatory is covering both simultaneous shutdowns of all units in a system and as well as all units at a station.

And depending on what sentence you are reading, it's referring to either one of those situations. And I believe that sentence in the third paragraph, the last sentence starting with diversity, I

think that's referring to diversity of equipment from station to station, that because of that diversity it is unlikely that there will be the need for a simultaneous shutdown of all units in all stations.

Q. Could you turn to page 12, please, of Exhibit 647?

MR. DALY: A. Mr. Mondrow, before we leave that point, I think there is one other remark that may be worth making. When operating the plants we normally follow what we call a lead unit concept. And that is normally the oldest unit, but not always. And typically, when you first hit a particular problem, it would normally arise on the oldest unit first. And that, then, gives you time to sort out the engineering changes required and do it at a later time on the younger units.

So, in that sense, because we typically have, say, six months to a year between units, we are looking at the problems that are coming up on the lead unit. And that also makes it unlikely to have these simultaneous shutdowns.

Q. But by identifying a problem on a lead unit, then you know that you are going to have to take down the other units, hopefully in a planned way, to address the same problem. That's what you are

telling me, isn't it?

A. Well, what I'm telling you is that the maintenance or the change you need to do on these later units, in many cases, can be done. Some of it can be done on power. Some of it can be done during planned outages which are there for other reasons. So you have that opportunity to benefit from your experience on the lead unit.

Q. Page 12, please, of Exhibit 647, Mr. Penn. There's a newspaper article there. I would like you to look at the fourth column, please, first full paragraph. Mr. Eliesen, your Chairman has said to have said that.

> Hydro has little choice but try to improve the performance of the nuclear system because the utility has become so dependent on this source of power.

MR. PENN: A. Could you just -- I have not found where we are.

Q. In the fourth column, first full paragraph.

A. Yes, I have got it. Thank you.

Q. And your chair has reported to have said that:

> Hydro has little choice but to try to

improve the performance of the nuclear system because the utility has become so dependent on this source of power.

I don't see in that paragraph any comforting reference to diversity. The implication to me seems to be that there are common problems with the system. I take it from your testimony that you wouldn't agree with that interpretation.

A. No, I wouldn't agree with your interpretation. As Mr. Daly has testified, the reasons for the performance decline that we have seen certainly in the mid-to-late 80s and which we have now taken steps that he discussed in great detail to address, are problems of a different nature and in different plants.

All Mr. Eliesen is commenting on here is the fact that reality is that in Ontario, and I testified to this, that by 1993 we will be producing some 60 per cent of our electricity from our nuclear system. And that's a fact.

And we have recognized that whereas we did in the past operate at capacity reactors that were often above 90 per cent, which by any stretch of the imagination is like the best in the world, we are now not doing that. And we want to readdress that and get back to that excellent record.

Q. Your fossil system and your hydraulic system don't seem to be getting the attention that the nuclear system does in terms of people perceiving problems with it. Isn't it fair to say that you have had a lot more problems with your nuclear system than with the other technologies on your bulk electricity system?

A. I don't think Ontario Hydro has had a lot of trouble with any of its system relative to other circumstances around the world. We have had our share of problems with our fossil plants. We had serious safety problems with the downcomers and the boilers at Lakeview generating station.

That's why we spent a lot of money renovating those plants, over a billion dollars. Actually, nearly $1.1 billion. We have had problems with our generators, I think, at Nanticoke. We certainly had vibration problems with our generators at Atikokan.

They are not chronic problems. They have been dealt with. And in context with this sentence you have brought me to, our fossil stations are used for intermediate and low capacity circumstances. Particularly our oil plant, of course, because it's so expensive to run it.

Q. Mr. Penn, do you think that the public perceives that there have been a disproportionate number of problems with Ontario Hydro's nuclear system?

A. Well, certainly the word "nuclear" captures the imagination of the media, and that's why the public are more aware of it. I don't think anyone is very interested in hearing about a coal-fired station.

Q. Mr. Penn, would you agree that delays or in fact terminations in nuclear plant construction due to government or regulatory direction or public opinion pressures has been a fact of life in many jurisdictions?

A. It's been a fact of life in the United States of America. It's not been a fact of life in France. It really hasn't been much of a factor in Ontario.

Q. It's been a fact of life with Darlington, isn't that true?

A. Well, the delays at Darlington, as we testified in great detail, and I guess Exhibit 537, some more than three-and-a-half years of the total five-year delay per unit was done for planned reasons, and for financial reasons and reducing load growth and

nothing to do with the plant, itself.

Q. There is a moratorium on now placed by the government which has stalled your plans --

THE CHAIRMAN: Not on Darlington.

MR. MONDROW: No.

Q. Which has stalled your plans with CANDU "A", Mr. Penn? That's a government direction, isn't it?

MR. B. CAMPBELL: Who said the moratorium was stalled the plans of CANDU "A"?

MR. MONDROW: Q. Mr. Penn, you were working on CANDU "A" and you stopped working on CANDU "A" when the moratorium was put in place, is that correct?

MR. PENN: A. Yes. Our board of directors, on May the 15th, 1990, approved proceeding with what we call the definition phase of CANDU "A", which was to prepare an environmental assessment. And at the request of the government, on or about the 22nd of October, just prior to the Speech from the Throne, we received an indication that we should not proceed further.

Q. I think, Mr. Penn, your evidence has been that acceptability is a "major" problem with nuclear power. Do you remember testifying to that?

A. Well, I would prefer to--

Q. Look at it?

A. --see exactly what I did say and in what context.

Q. Transcript Volume 127, please.

THE CHAIRMAN: Page? No. 22250.

MR. MONDROW: Page No. 22250.

Q. The questioner says at line 8:

Social acceptability remains in question. And that is the major problem that nuclear power faces, is it not?

And you say at line 12, "It is one of the problems, yes."

The questioner goes on, "A major one?"

And you say at line 14, "It is a major one, yes."

You can confirm that testimony, Mr. Penn?

MR. PENN: A. Yes. The point that Mr. Hamer, I guess, was pursuing with me was, he used the words "and that is the major problem." And I was trying to say, it's not the major problem, it's one problem. And yes, acceptability of nuclear power in society is a matter that needs to be continually addressed.

Q. It's a major problem. That's what

you said.

A. That's what I said.

Q. It would not, then, be unreasonable to expect delays or political hesitation or vacillation for a nuclear power project.

A. Well, I think that's speculative because whatever delays a nuclear power project depends upon the circumstances of the day. As I recall, one of the reasons why the Minister of the Environment exempted Darlington from an environmental assessment hearing was, at that time, the province had a very high growth of electricity and every one was very concerned that we wouldn't be able to meet demand. And reliability would be affected and society would be a affected. So it just depends what the circumstances of the day are.

Q. Well, we are not in those circumstances now, are we, with respect to demand, nor are we with respect to public opinion or government opinion for that matter.

A. You are quite right.

MR. DALY: A. I might point out, Mr. Mondrow, that social acceptability is not just limited to nuclear power or unique to nuclear power. There are social concerns on the use of fossil fuels. So as a

society you have to look at the social acceptability of all the different types of power production. There are significant concerns on fossil fuel use.

MR. PENN: A. I think one could even generalize and say there's concerns in our society today for virtually everything we do in life.

Q. We have seen in the United States where some plants have, in fact, been stalled after construction has commenced that public opinion and government opinion forms a very real cost risk for nuclear power projects of the future, would you agree with that?

A. There have been examples of that, yes.

Q. And that poses a significant cost risk.

A. It certainly does.

Q. I would like to turn to Exhibit 539, please. Mr. Penn, this was the Darlington exhibit I think you were referring to a minute ago.

Page one, please. Third paragraph, second sentence. Starts "In Darlington's case."

Mr. McCredie here says that:

> In Darlington's case the media tend to compare the current estimate to much

earlier estimates which are inappropriate due either to their preliminary nature or their exclusion of inflation or interest costs.

The logical conclusion from the reference to preliminary nature there, Mr. Penn, seems to me that Ontario Hydro's preliminary estimates are unreliable. Would you agree with that?

A. What Mr. McCredie is referring to here is what is known as release estimates. And quite often in major projects in Ontario Hydro, we even have partial release estimates. This means that it relates to the level of confidence in whatever the undertaking is with regard to the extent of design completed. And in this particular case, when we sought approval from our board to start the definition phase of Darlington, I believe that less than 5 per cent of the engineering was complete.

[11:00 a.m.]

And the whole purpose of doing the definition phase, which culminates in the commitment of acquisition, that is to build the plant, to pour the concrete, clear the ground, is to then provide confidence to the board, and our board, that we have now done sufficient engineering that they can be able

to take the decision on whether we should proceed or not, and when we get to that point it's called the definitive estimate. That's what is referred to in the fourth bullet on that page that reads:

> The appropriate starting point for analysis of Darlington costs is Hydro's 1981 estimate of 7.4 billion.

In fact, that is the definitive estimate which the project is monitored against.

Q. Mr. Penn, when Ontario Hydro put forth its released estimate for Darlington, you had already done engineering for other "B" series stations.

THE CHAIRMAN: Mr. Mondrow, you are familiar, we have gone over this ground over and over again with other cross-examinations. I don't think there is much more to be gained by going over it again.

These particular issues have been well explored. You may not agree with their analysis but I don't think its helpful to us to have Mr. Penn repeat evidence that he has given several times already.

MR. MONDROW: I agree, Mr. Chairman. I am actually going to ask one question that I don't think has been asked before and I will move on after that.

Q. The real point here, Mr. Penn, that I

was going to make, is that when you did your release estimate for Darlington you had already completely designed two other "B" series stations. A minute ago you told me that Darlington was a "B" series stations.

I don't understand why you were so uncertain about Darlington when you put together the release estimate?

MR. PENN: A. Well, it's certainly true that conceptually, this comes back to what is the meaning of the word "standardization", that the Darlington style plant is based nominally on Bruce "B". Of course we were only about a third of the way -- maybe Mr. Daly can help me here. I was going to say we were only a third of the way through building Bruce "B" when we first committed or started work on Darlington. But there are, even though there is conceptually a standardized approach, there are significant differences at Darlington, for example with regard to meeting seismic needs, just as one example.

Q. For CANDU 6, Mr. Penn, you testified that you have confidence in the numbers that AECL has provided you, in the fact because they have just provided you the numbers that they quoted to Korea on their recent sale.

Mr. Penn, isn't it true that AECL has in

fact been almost giving these reactors away to open up overseas markets?

A. I am afraid that I am not familiar with the contractual negotiations that AECL have with its clients.

Q. You agreed with Mr. Poch that you don't have anything akin to an option at that price, if I recall; that's correct?

A. I'm sorry?

Q. When you go to buy a CANDU 6, if you go to buy a CANDU 6, that price is not guaranteed?

I think you have already answered that question.

A. We haven't entered into discussions about that sort of thing. There likely could be several avenues.

There is certainly, just for your interest, there are certainly contractual obligations on Atomic Energy of Canada with regard to the building of the present CANDU reactor, CANDU 6 at Wolsung, very significant requirements have to be met in order to keep to the price quoted.

Q. In Panel 2 we asked Mr. Barrie about the then current in-service date estimates for Darlington. You don't have to turn this up. For the

record, it was Volume 22, at 3996, it was June 3rd, 1991. And you told us that the nuclear people, I guess the nuclear division had told him to expect Darlington on line by November of 1991, but that, just in case, they had contingency plans until the end of the year. Obviously that didn't come to pass.

Do you know, by any chance, how far out their contingencies are going now for Darlington in-service? 1 and 2 this would be, I would imagine, and perhaps 3 which is supposed to be 1992.

A. I am pretty sure that Mr. Daly has testified to this, that the scheduled in-service dates for Unit 1 and Unit 3 is about late August this year.

MR. DALY: A. Yes, that's correct. Both Units 1 and 3 were mid-August this year.

MR. PENN: A. Unit 4 is spring of next year.

Q. Mr. Penn, I am not asking about in-service dates, you have testified to that.

I am asking about the contingencies of the operations people. If they don't get Darlington now --

A. I am just coming to that.

That's based upon the fact that the seven blade vein impeller will solve the heat transport

problem that we have, and the contingency is, if it doesn't, that it will add six months to those in-service dates.

Q. And do you know if operations has done system planning contingencies to meet that eventuality, six months or longer?

A. Are you referring to the power system operating division?

Q. Yes.

A. The group that supplies the power to Ontario?

Q. Yes, group that Mr. Barrie testified on behalf of in Panel 2.

A. I am quite sure, I am not familiar with the detail, but PSOD are very familiar with the circumstances at Darlington.

I don't know if Mr. Daly can help me on that one.

MR. DALY: A. Yes. PSOD are well aware of the potential for further slippage if the seven vein impeller doesn't prove to be a total fix.

As part of our routine annual processes we have what we call a short range bulk electricity system plan which we do every year. And we look at the potential problems, potential surprises, contingencies

that need to be put in place. So that is an ongoing process done every year.

As Darlington evolves and particular scenarios could come to pass, PSOD factor those on a routine basis.

Q. How far out does that projection go?

A. It's short range. You are really looking at the sort of two upcoming winters. So it's really looking at the short-term winter peak.

The next process we have is the consistent energy set process which goes over a five to six year -- actually six year period, and then we have the long-term planning which goes 10 years and beyond.

Q. Back to Exhibit 539, please, page 3. The second bullet, I guess, on the page, actually the second part of that bullet, Mr. McCredie refers to the 11.8 per cent rate increase, and then with a little addition there, it tells us that 6.6 per cent of the rate increase or 6.6 per cent rate increase is attributable to Darlington and other nuclear costs.

In 1993 the proposed rate hike is 8.6 per cent, and I would like to you confirm, please, if you can that 6.7 per cent rate increase or over three quarters of that rate increase is also due to Darlington and other nuclear costs.

Can you confirm that?

A. Are you quoting from a particular page?

Q. I don't have a particular reference, no.

Is that in your knowledge, what percentage of the 1993 rate increase is due to Darlington and other nuclear costs? Does 6.7 per cent sound right? If you don't have it handy, you can undertake to get me that number if you wish.

A. It's certainly in the right order of magnitude, but perhaps I could check it at the break.

Q. That would be fine. Thank you.

MR. PENN: A. I think I can perhaps save us the need to do this.

If you go to Ontario Hydro's submission on 1993 electricity rates, which has not been given an exhibit number yet.

Q. Exhibit 571, I believe, Mr. Penn.

A. 571.

And turn to page 3, table 1.2, and on the right-hand column--

Q. Yes, thank you.

A. --where the total rate is given as 8.6 per cent, at the bottom of that table you will see

that Darlington in-service and other nuclear costs contribute 6.7 per cent.

Q. Thank you. While we are in that exhibit, unless you have another comment, could you turn to the appendices at page 91. This is appendix 5 of that document, it's headed Net Income Sensitivity.

If I understand this appendix, it seeks to evaluate in an approximate way the impact of unexpected variances and actual events that are projected that could have an impact on the 1993 net income. Is that your understanding of this appendix, Mr. Penn?

A. Well, I haven't read it yet. So all I can say is subject to me reading it, I will accept that.

Q. That is fine. If we could turn to the next page, please, we have a table which illustrates that. You will see that there is a planning assumption in the left column and there is another assumption, there is a forecast change due to this other assumption and then there is a net income sensitivity due to the change.

I am interested in the in-service dates category. You will see Darlington Unit 4 is listed there and that table says to me that with a one-month

delay in in-service for Darlington 4, Ontario Hydro saves $37 million. Is that how you read that table?

A. Well, the process that's always been used in Ontario, in Ontario Hydro in particular, is that we don't start depreciating any form of generating unit, nuclear or otherwise, until it's declared in-service.

So, in fact, all that is, what it is saying, well, is instead of the plant going in-service in March 1993, it goes in-service in April 1993, then one month's depreciation of that unit is worth $37 million.

Q. That's from a net income perspective. But of course from a total cost perspective it's better to bring the unit in on time, it costs less that way; right?

A. Well, from a point of view of generation cost to the system, yes.

Q. But for the first while Darlington 4 is going to cost a lot more than it's going to make; is that right? It's a high capital cost project and you have to depreciate it for a while before you get to the break-even point.

A. Well, I think you are getting into an area that I don't have knowledge of, and as much as I

dislike handing things over to other people, Dr. Long, who is a member of Panel 10, and the chairman of the Depreciation Review Committee, is very familiar with this subject.

Q. Is another factor with Unit 4, and in fact Unit 3, I think, Mr. Daly, you told us the other day those unit are radioactive yet, but once they go critical the maintenance costs and practices are increased because of the criticality, the radiation involved, and of course you generate materials that will eventually become wastes. Before it goes critical it is just like any other building; right?

MR. DALY: A. Before it goes critical there are a few precautions. If the heavy water is in the system and if the heavy water included some tritium, then there would be some precautions, but I agree, not as extensive as they are during routine operations.

Q. So before they go critical it's easier to maintain them; after they go critical the costs go up, maintenance costs go up; is that fair?

A. It would depend on what particular system you were working on. Some systems are equally accessible whether the heat transport system is active or not.

So, I think what you are saying is true on certain systems but there are other systems, for example, half the plant is the conventional side of plant and really it doesn't make any difference.

Q. But overall costs will go up?

A. Overall maintenance costs, yes, they would tend to go up.

Q. Back to Exhibit 539, please, appendix 1. I noted with interest the row of LUECs there, the 4.5 for new fossil and for Darlington and for Manitoba. In footnote 3 we are told that for comparison purposes Darlington is an estimated incremental LUEC, and the accounting LUEC for Darlington is in fact five cents.

Can you tell me, Mr. Penn or Mr. Daly, from where this incremental figure runs, from what point in time?

MR. PENN: A. The way I interpret that is that the LUEC given for Darlington is on a system expansion basis as opposed to a direct and allocated basis, which is what I assume the number five cents kilowatthour is. In other words, on a system expansion basis, of course you are, for example, taking advantage of the acids that we have got in the heavy water production plant, because we built them a long time ago and we have depreciated them a great deal.

Q. Are there any other large factors akin to the heavy water plant that the system expansion cost would exclude?

A. Well, I am sure there is a whole series of things. It's certainly discussed in the ONCI document, Exhibit 43, and we could get that out, to refresh my memory on the matter.

Q. No, that is fine. We can get that out and take a look that, too, if we have any more questions.

Could you turn to page 18 of our interrogatory package, please. That's interrogatory 9.14.4.

I think I should have a number for that please, Mr. Lucas.

THE REGISTRAR: .130.

---EXHIBIT NO. 520.130: Interrogatory No. 9.14.4.

MR. MONDROW: Q. If you look at the response to that interrogatory, please, under B, we were told that no attempt is made to track the incremental or system explanation costs of a committed project, which is why I asked the question about the LUECs, Mr. Penn. In light of Exhibit 539, I wonder if we could get an undertaking to produce the calculations behind the Darlington incremental LUEC used in that

exhibit?

MR. PENN: A. Well, before we do that, I am afraid I wasn't following your preamble.

Q. Well, Mr. Penn, in the interrogatory we asked for the incremental or system expansion costs for Darlington, and the answer says that you don't do that so we didn't get it. Now we see that it has been done, can we get it?

THE CHAIRMAN: That's what we have to be sure about.

Has been it been done?

MR. PENN: I don't know, Mr. Chairman.

MR. MONDROW: Q. Well, Mr. Penn, we are given an incremental LUEC of 4.5 in this exhibit here. Note 3, that I took to, says that this is an incremental LUEC for Darlington.

MR. PENN: A. That was my interpretation.

Q. Could you undertake to see if that is in fact correct, and if it is in fact correct, to get us the calculations, and if it is not in fact correct, to tell us?

Could I have an undertaking number please, Mr. Chairman?

THE REGISTRAR: 532.14.

THE CHAIRMAN: Thank you.

---UNDERTAKING NO. 532.14: Ontario Hydro undertakes to provide the basis of 4.5 cents LUEC in Exhibit 539, appendix 1.

MR. PENN: I don't know whether we have got a problem with terminology here. The question reads: Please provide data giving the accounting cost capital expenditures. And then the answer is, well, the accounting cost capital expenditures for design and construction by cost stream are as follows.

MR. MONDROW: Q. Yes. Could you look at part B, please. Part B says:

Please provide data giving the system expansion cost capital expenditures for Darlington.

And part B of the response says that you don't do system expansion costs. Exhibit 539 sets out a system expansion LUEC. So I would like to get the calculations.

THE CHAIRMAN: Well, isn't the best thing for Mr. Penn to go back armed with all these questions and then it could be dealt with in the undertaking response.

MR. MONDROW: That would be fine, Mr. Chairman. That's what I am asking him to do.

MR. PENN: I can certainly do that, Mr.

Chairman, but there is a confusion. Levelized unit energy cost is a single number for a lifetime.

[11:20 a.m.]

These accountings costs are being given for different years.

MR. MONDROW: Q. I'm sorry, Mr. Penn. I don't understand your concern.

MR. PENN: A. Just because we have given system expansion LUECs doesn't mean to say we can give system expansion costs on an annual basis.

Q. Well, perhaps you can give me what system expansion costs you do have that are behind this 4.5 number, the calculations, and we can take it from there.

THE CHAIRMAN: I think what we have to get is what is behind the number in appendix 1 to 539.

MR. B. CAMPBELL: I think we already have given an undertaking to do that, Mr. Chairman.

MR. MONDROW: And that's the number we just got. That would be fine, thank you.

THE CHAIRMAN: That's what you need. I don't think you need to reference 9.14.4. What I really see you need to provide is where you get the 4.5 from in appendix 1.

MR. PENN: We would be happy to do that,

Mr. Chairman.

MR. MONDROW: It may be, Mr. Chairman, that when we see what is provided have some questions going back to this Interrogatory 9.14.4 because, obviously, some calculation has been done. And we can deal with that when we have the undertaking.

THE CHAIRMAN: We will have to see.

MR. MONDROW: Thank you, sir.

Q. Mr. Penn, would the 1975 Darlington cost estimate have included a contingency?

MR. PENN: A. I'm sure it would, yes.

Q. You don't know what that number was, by any chance?

A. I don't know, no.

Q. Would the contingency have been applied in the same way you are applying a capital cost contingency to a future station?

A. I don't know. I wasn't responsible for that work. I don't think I was even employed at Ontario Hydro then.

Q. Well, we do know that you do apply a capital cost contingency in your planning now. And we can see that interrogatory --

A. It's 15 per cent for proof of designs.

Q. For the 4 by 881?

A. Yes.

Q. If you could turn up page 145 of our interrogatory package, please.

THE CHAIRMAN: 145, you say?

MR. MONDROW: I'm sorry, sir. My pages are not the same as yours, I see. Excuse me one second. I'll check one of the printed packages.

Yes, it is 145. 9.44.2, it is the cover page for the interrogatory. And that's already been given an exhibit number. It's 520.29.

THE REGISTRAR: That is correct.

MR. MONDROW: Q. And then on the next page of our package, 146, we have copied one page from that report, page 4, from the report attached to the interrogatory response.

And you'll see at paragraph 11 it discusses the capital cost contingency that Ontario Hydro does, in fact, apply for its estimates for future stations. And if you look about halfway down the paragraph, the sentence starting "This contingency," it reads:

> This contingency is to cover uncertainties in cost estimates, economic factors, and regulatory changes, major

scheduled delays and significant cost changes due to major unforeseen regulatory or technological changes are not fully covered. These could happen to any option and are considered in overall planned assessments.

What does that mean, Mr. Penn, to be considered in overall plan assessments?

MR. PENN: A. Well, I think what it means, and to draw an analogy by going back to Darlington, if you look at Exhibit 539 and appendix 2, which is the table that gives the, and I don't think people need to look this up again, but it gives the plan schedule change, which is something that cannot be foreseen.

What it means is that every time there's a planned scheduled change to Darlington or any of the units, then system planning does a financial evaluation to assure ourselves that given this delay and compared with other options, that it's still economic to proceed. And I think that's what this sentence means in referring to "in overall planned assessments."

Q. I'm sorry, Mr. Penn. I'm confused then? I thought this report talked about the future station and the contingency you apply to the future

station. So I wondered how, in application to future plans, you consider uncovered contingencies in overall plan assessments. That might be a Panel 10 question, Mr. Penn?

MR. B. CAMPBELL: I'm sure Panel 10 would be a more appropriate plan to deal with that issue.

MR. MONDROW: That's fine, Mr. Chairman. I will ask Panel 10.

Q. Just so we understand, though, what is in and what is out of the nuclear contingency for future stations, I would like to go through some of those, some of the actuals on Darlington. And perhaps you can just tell me whether they are or are not included in this contingency

To make it a little easier, we have done an overhead which I would ask be turned on, please. That's in Exhibit 647 at page 13. And you can see I have just put up the categories that we just looked at.

So under Included we have cost estimate uncertainties, economic factor uncertainties, and evolutionary regulatory changes.

And under Not Included we have major regulatory changes and major technological changes. And I would like to go back to Exhibit 539 and just see what actually happened at Darlington and whether you

have included that kind of thing for a future station in your contingency.

First, as a general question, Mr. Penn, Exhibit 539 is replete with comments on the complexity of Darlington. I take it that you would agree that nuclear facilities are large and complex facilities.

MR. PENN: A. Yes, they are large.

Q. Are they complex?

A. And they can be.

Q. Thank you. Would major regulatory changes be more likely with large and complex facilities?

A. I don't think so necessarily, no.

Q. If you go to page two, please. Second paragraph, second sentence. Mr. McCredie says:

> A complex nuclear power facility such as Darlington with a large capital cost and requiring a long lead time before being placed in-service, is at risk if major planned schedule changes occur because of the decline in load forecast.

And, in fact, that was 70 per cent of the Darlington delays, Mr. Penn, as you have testified. Delays due to reduced load growth are not included in the future contingency, is that right?

A. Correct.

Q. Pickering "B" was, in fact, a later year due to lower than projected growth. You have already testified to that. Do you recall that?

A. Yes.

Q. The fourth paragraph on page two, please. Second sentence. "Approximately 70 per cent of," I guess I should start at the first sentence:

> Appendices 5-1 and 5-2 together summarize the major factors contributing to the overall cost increase of 6.4 billion dollars since 1981. Approximately 70 per cent of this increase is primarily interest associated with scheduled delays and financial policy changes.

That's the 70 per cent we just talked about.

> And the balance representing scope changes mainly due to more stringent regulatory requirements and estimate changes resulting from the complexity of the project.

Would more stringent regulatory requirements have been addressed under the evolutionary

regulatory changes category of the contingency for future stations?

A. Yes. As I have testified before, the number of man hours and the total cost associated with regulatory issues for a future 4 by 881, is taken to be the same number as occurred in Darlington.

Q. You are going to incur the same number again for your future station as you occurred getting from Bruce "B" to Darlington.

A. That's the assumption we have made on the basis that it's conservative.

MR. MONDROW: Mr. Chairman, perhaps we could take a break now.

THE CHAIRMAN: All right. We will break for 15 minutes.

---Recess at 11:30 a.m.

---On resuming at 11:50 a.m.

THE REGISTRAR: Please come to order. This hearing is again in session. Please be seated.

MR. MONDROW: Thank you, Mr. Chairman.

Q. Before the break we were going through Exhibit 539, the Darlington material and we had the overhead - I would ask you if it could be turned on again, please, for a few minutes - which breaks out what is included and what is not included in

contingencies for future nuclear projects. We had gone to the text, and I would like to turn to appendix 2, Mr. Penn, which you referred to a bit earlier. And as you say, this is a schedule of the delay and there is list of the reasons for the delay. If we could run through those quickly, I hope.

A and B both reduced load growth and we have already talked about that. C is an advance in the schedule.

MR. PENN: A. Yes. Well, looking at your slide, and of course I presume this is your material, your client's material, you should have under Not Included, planned changes to schedule, which is going back to appendix 2, what we are talking about that's shown on the upper left part of that table.

Q. That's what we talked about before the break?

A. Yes. So you don't have in this overhead the entry planned changes to schedule, which should be under the Not Included part.

Q. Okay. So we were at the schedule, we did A and B, C is an advance.

D is a reduction in borrowing and load growth and other delay. The load growth part of it we have talked about. And the reduction in borrowing, you

have also mentioned before capital intensive projects would be vulnerable to borrowing constraints, so a future station would be as well; is that fair, Mr. Penn?

A. Well, I don't think that necessarily follows. I don't recall the exact circumstances, but I think the provincial government asked Ontario Hydro to reduce its borrowing at that point in time because the provincial needs were significant as well. So it doesn't necessarily follow that that sort of thing would be carried through to any other project.

Q. Well, a nuclear project is capital-intensive, you have had agreed to that. Capital-intensive means you need a lot of money up front, you have to borrow.

A. You only borrow the money as you need it. We don't borrow money specifically for a project; we borrow money - and again this is Dr. Long's area in Panel 10 - we borrow money in one part for the whole corporation and we float bonds and that's how we do it several times a year.

Q. Yes, I am not concerned with the mechanism for borrowing. Borrowing is not included in the contingency for the future station, restraints on borrowing; right?

A. No, that's also under the Not Included.

Q. Right. Thank you.

E1 mentions a strike. Strikes aren't included either under the contingency, are they?

A. No. I take the view on contingency, if I have no basis to define a contingency, then it could be anything and I can't therefore do it.

Q. That is fine. I am trying to go through what actually happened with Darlington and just on an item by item basis, and if that's your answer, that is fine, say what is included and not included.

So we have agreed that strikes aren't included.

And E2 is an advance, as a matter of fact, and it says site manpower leveling. Does that mean that you got more construction people?

A. No. What it meant was that we had construction workers on site and it would lead to lower cost if we used those as they came off work on Units 1 and 2, to put them on Units 3 and 4, to level the workload across the whole site.

Q. Okay. Under item F we have recognition of more complex engineering and construction workload. What does that mean?

A. Well, that's what I would call a scope change, and that should be under your included category. Contingencies are for estimate changes, scope changes, economic factor uncertainties.

Q. Excuse me, Mr. Penn, this is your category, this is from the document that Ontario Hydro provided in response to the interrogatory.

THE CHAIRMAN: He said it should be included in the top line there. That's what he said.

MR. MONDROW: Q. So scope changes is included, subsumed under cost estimate uncertainties; is that what you are saying?

MR. PENN: A. Yes. I don't have any argument with the fact that cost estimate uncertainties are included; yes.

Q. And scope changes would be included under that heading?

A. Well, it's separated out. When we do a variance analysis, which is done every year on a major project, so that you could determine how well you are doing relative to estimate, and in the variance statement you would have a category for scope changes and a category for estimate changes, and a category for financial changes.

Q. Okay. Then are you saying that scope

changes are akin to evolutionary regulatory changes? I am just trying to determine which of your categories this goes under?

A. It is akin to it. But scope changes could be a change in scope on anything in the plant.

Q. Part of the next delay, item H, is attributed to late turnover of more complex systems to operations. What does that one mean?

A. Well, it would be reflected in an estimate change, because when you estimated the job you would say, we need several hundreds of thousands of man hours of work to construct the vacuum building, shall we say, and it turns out that it takes either shorter or longer to do it. So in this case it took longer.

So the system wasn't turned over to operations to commission it when we expected to do.

Q. And under item G, the second explanation is a limited number of trained operating staff. Is that included under the contingency?

A. Yes, it would be, and because it's a matter, or at least it should be, it's a matter that's under the project control.

Q. So which of the categories from Ontario Hydro's interrogatory response would that be under?

A. Well, it would be under estimate changes.

Q. Okay. And under H we see further references to staff shortages and we see a delay to meet more stringent safety requirements. Would that be included under evolutionary regulatory changes in the included category?

A. Yes.

Q. Okay. And the last point under H is the cascading effect, which is in fact explained by Mr. McCredie on page 3, and that is the additional operating staff required as result of more stringent regulations, so that also would be included under evolutionary regulatory changes then; is that right?

A. I wouldn't think so. I think what Mr. McCredie is referring to here is that if he has had construction workers associated with Units 1 and 2, and they have been there longer than they expected to be, than it would affect progress on the other units.

Q. So that would not be included?

A. It would be part of the project control, so yes, it would be included in contingency.

Q. Item I is a catch-all, a contingency for unforeseen problems. And I take it, Mr. Penn, from your earlier comments that that of course is not

included under the contingency, it's unforeseen?

A. No, it wouldn't be, because what is been referred to there is the primary heat transport troubles we have had and, of course, the crack in the generator rotor, which you can't foresee that sort of thing.

Q. No way to foresee, so it's not under the contingency that you allow?

A. No.

Q. Item J is operation resourcing difficulties. What is that?

A. Well, I think I would probably ask Mr. Daly to comment on that.

Q. Is that a staff shortage, in essence?

MR. DALY: A. Some of the delays at Darlington were due to unavailability of staff who were being transferred from Pickering and Pickering was still in the retubing program at that time. So there were some delays in transferring Pickering staff to Darlington.

Q. Would that be included in the contingency?

MR. PENN: A. It wouldn't be specified as a reason for defining contingency.

I can look up what the number is, but in

the fossil cost review document there is a whole chapter that I wrote on how you estimate contingencies, what process you go through, including probabilistic processes, and it gives you a full description there of the nature of the issues that one considers in arriving at a contingency and how you come up with that range estimates, based upon, of course, very large data bases that we have on these subjects.

Q. The fuel referred to item J is also unforeseen and so would not be included in the contingency; right? You just talked about the --

A. No.

Q. And item K is a continuation of those problems?

A. It's the cost of modifying the impellers in the pumps, and the fuel, of course, that had to be replaced that was damaged.

Q. Yes. While we are on the subject of contingencies, another final question, please, about fueling contingencies.

We went through the CNA brief at the outset of my cross-examination and we saw references to proposed regulatory changes which could have severe impacts on uranium mining viability. I have looked in your ONCI submissions, which is Exhibit 43 and I have

looked in the Nuclear Cost Update, Exhibit 520.4, but I didn't find any reference to fueling cost contingencies. Did I miss that? Specifically for regulatory reasons, is there a contingency for fueling cost contingencies?

A. Well, contingencies are usually associated with the design and construction of the plant, that that is capitalized. There usually isn't.

I have never heard of anybody putting a contingency in the procurement of fuel. This is matter that is negotiated, and obviously Hydro looks for the lowest priced uranium, and that's one of the reasons we have recently moved our requirements from Elliot Lake and we are looking for other markets, because we can buy uranium at a much lower price.

Q. There is an uncertainty for fueling costs in ONCI, but regulatory uncertainty was not mentioned, if I am correct. Can you confirm that?

A. With regard to--

Q. Fueling costs.

A. --it's impact on U(3)O(8)?

Q. Yes.

A. I would suggest that is a contingency that the mining companies have to allow for.

As I say, we have long-term contracts

with companies.

Q. Okay. I am finished with the overhead. Thank you.

Mr. Penn, could you turn up Exhibit 641, please. This was an overhead that you filed last week.

This exhibit plots the total dry costs in 1991 dollars for all of the existing plants and the future options, using a 4 per cent interest rate.

You would agree, Mr. Penn, I trust, that nuclear plants being capital intensive are considerably sensitive in terms of cost to interest rates? Would you agree with that?

A. Yes, I do.

This is a 4 per cent real interest rate.

Q. Yes, sir. Four per cent real.

Four per cent real isn't Ontario Hydro's corporate financial discount rate, is it?

A. Well, again, this is a subject for Dr. Long because it's specifically financial, but the discount rate in my understanding has varied between about sometimes 3-1/2 per cent as high as nearly 6 per cent.

The reason that a 4 per cent real interest rate is chosen in depicting this sort of information is that it comes from the electric -- it's

part the electric utility cost group curve, and we, in conjunction with utilities in the United States and France and elsewhere, have agreed that we will use for comparison purposes, a 4 per cent figure so that we can compare costs on the same basis.

Q. When you do your planning estimates do you use the 4 per cent to compare your own options internally?

A. Would you repeat the question, please?

Q. When you do your internal planning decisions, when you decide which options are cost-effective and which aren't, do you use the 4 per cent number that this association uses or do you use another number?

A. We use the long-term financial indices in the corporation that our chief economist produces.

Q. Could you undertake then to provide revisions of Exhibit 461, revised to reflect each of the 5 per cent and 6 per cent real interest rates, and as well provide a disaggregation of the numerical data behind the results that are plotted?

MR. B. CAMPBELL: Just a minute.

Mr. Chairman, I'm not at all prepared to

give that undertaking until we find out how much work is involved. We have dealt with 1,500 interrogatories in this panel, and I don't know whether this is covered there, but we have done an awful lot of work and preparation. I am not willing to take on a whole bunch more until I have some sense of what is involved, which I don't have right now.

THE CHAIRMAN: All right. We will hold it in abeyance until you find out what is involved.

MR. PENN: Well, to be helpful in this matter, I don't know what exhibit number is, but Interrogatory 8.2.14 provides a disaggregation.

MR. MONDROW: Q. Does it provide the figures at 5 per cent and 6 per cent real interest rate?

MR. PENN: A. No, just at 4 per cent.

MR. B. CAMPBELL: Well, Mr. Chairman, I would suggest that with the resources that are available to the intervenors and having an example of how it was done at the 4 per cent, that they can do the sensitivity themselves.

MR. MONDROW: I am advised, Mr. Chairman, that we don't have the data on a time basis, and it's not a proportional calculation. It would be difficult, if not impossible, for us to do.

I would submit that Ontario Hydro for its internal purposes at least does these calculations using the corporate financial discount rate, and so presumably their program should have a facility to use sensitivities around that rate.

THE CHAIRMAN: Well, we are going to find out if they have got it. If they have got it, they will let you have it; if they haven't got it, they perhaps won't.

MR. MONDROW: Perhaps, Mr. Chairman, I could just add that we could be advised if it is doable with a reasonable amount of effort, whether they have actually done it or not and we could take it from there, if that would be acceptable.

MR. B. CAMPBELL: Mr. Chairman, I think the problem I am having with this is that we have provided all kinds of information for a future station based on corporate financial discount rates, that's the whole basis of the cost estimates. We have answered zillions of interrogatories on those cost estimates already. What is being asked is to go back and recalculate for the whole nuclear program on that basis and I am not, as I say, I am certainly not prepared to undertake that at this point in the proceedings.

THE CHAIRMAN: We won't make them do

this.

[12:10 p.m.]

MR. MONDROW: Q. Mr. Penn, could you turn up Exhibit 87, please.

MR. KING: A. Can you tell us what 87 is, please?

Q. 1991 Review of Generation Reliability Planning Criteria.

Do you have that, Mr. Penn?

MR. PENN: A. Yes.

Q. Could you turn to page 86, please. The second paragraph on page 86.

A. Eighty-six. I would like to note that while this is an Ontario Hydro report, it's prepared by system planning division and reviewed by Mr. Taborek and approved by Mr. Snelson, and I have no knowledge -- I have never read this document so I will certainly do my best. But I certainly don't know the context of what precedes page 86.

Q. I appreciate that, Mr. Penn. We will ask you about the nuclear factors discussed in here. And if you could comment, that will be helpful; and if not, we will have to come back to Panel 10. Do you have page 86?

A. Yes.

Q. You will see that the second paragraph on the page talks about the analysis that Ontario Hydro uses to assess average delays. You can see that in the first sentence.

And you can see that the data for that analysis, starting in the second sentence, were derived for the study using construction experience for mostly fossil and few nuclear units. And about three lines down from there you can see that the annual produces an average of about six months late.

The six month number, Mr. Penn, do you know if that would be the number used in the reliability indices for nuclear projects?

A. I can't help you. What the sentence actually says is:

> Based on a lead time of eight years, the in-service dates were found to vary between a reduction of six months and an increase of twelve months from the original in-service.

This is just the sensitivity that system planning having used models to deal with the sort of issues that we talked about earlier when we talked about delays at Darlington, what did PSOD do about meeting the load that would have been provided by Darlington if it

hadn't been delayed. And this is a model that evaluates that.

Q. And the output of the evaluation is an average of about six months late for facilities. Do you see that?

A. Yes, I see that.

Q. The last paragraph, the last sentence, gives us some more information on the analysis. And it says:

> The forecasting error was calculated by comparing the actual in-service date with the forecasted in-service date four years before. Four years is chosen to represent the lead time for combustion turbines.

Mr. Penn, when you are forecasting in-service dates for nuclear facilities, wouldn't it be the lead time forecast made at the time of the planning decisions that would be pivotal for the project being sanctioned rather than a forecast made four years before completion?

MR. B. CAMPBELL: Well, Mr. Chairman, I think this exhibit was the subject of cross-examination probably on Panel 2, I believe. I'm not sure that given what Mr. Penn has said and, frankly, it's been

witnessed once and it is clearly, the choice of the four years is clearly for some point in the planning process that these witnesses can fairly be asked to deal in any useful way with these types of questions.

MR. MONDROW: All right. I will take Mr. Campbell's point, Mr. Chairman. Let me rephrase my question.

Q. Mr. Penn, uncertainties in forecasts made 15 years in advance for nuclear in-service would be significantly greater than those made four years in advance for nuclear in-service, would you agree with that?

MR. PENN: A. Well, I agree that system planning do these types of reliability in-service assessments on an ongoing basis, I imagine on an annual basis, to reflect circumstances. You get closer and closer to completion of station. I can't say any more about that. I don't have knowledge of this particular analysis.

Q. Mr. Penn, in light of your counsel's comments, I'm not asking you about the particular analysis anymore. My question was, when you forecast nuclear in-service, forecasts 15 years in advance of the projected in-service date would be significantly more uncertain than forecasts four years in advance of

the in-service date. Would you agree with that?

A. Yes.

Q. Thank you. Leaving Exhibit 87 open just for a minute because I'm going to refer you to some numbers for our following discussion. If you could turn up Exhibit 211, please. 211 is entitled, The Statistical Analysis of Ontario Hydro's Increasing Nuclear Unit Delays and the Implications for Avoided Cost. It's an analysis done by Mr. Marcus that was filed by IPPSO in Panel 3, Mr. Chairman.

Mr. Penn, if you turn up table 1 of that exhibit, please. And if you turn up page 87 of Exhibit 87, which is the table that breaks out the data or the variance from the four years earlier forecast for all of the stations listed on that table, would you confirm for me, please, that the numbers under table 1 in Exhibit 211 column, the delay from four years earlier in months, are the same numbers as the error months column on page 87 of Exhibit 87 for the nuclear facilities?

A. Well, I have checked Bruce "A," and that seems to be the same.

Q. You have checked up to Bruce "A" or just Bruce "A"?

A. Just on Bruce "A." I'm going down

the table 4.9.

Q. Would you accept subject to check that these are the same numbers? I'm just trying to get you to confirm that we have used the data from your exhibit.

A. Yes, I will do that.

Q. If you find a discrepancy, you can advise us after lunch or later, whenever you find it.

I should make a correction for the record, Mr. Chairman. On this exhibit, on the first page of text, which isn't page numbed--

THE CHAIRMAN: Which exhibit?

MR. MONDROW: This is Exhibit 211, Mr. Chairman. On the first page of text at the top, the reference is given to Exhibit 87 for these numbers. You will see in the second sentence it says, "Given in Exhibit 87, table 4.22," and we can see it's actually table 4.9 in Exhibit 87. It's just a typographical error.

Just for the record I wanted to correct that.

Q. And I'm through with exhibit 87, Mr. Penn. We can pick up the specific nuclear questions in Exhibit 211 now. If you look at page 3 of that Exhibit 211, please, the second page of text, you see Mr.

Marcus' conclusion at the start of the first full paragraph. He says that:

> In sum, over the last 20 years Ontario Hydro has been having increasing difficulty in bringing nuclear units on line on time, even relative to the estimates made by Hydro only four years earlier.

Mr. Penn, I believe you have testified that some of your units have been late and some have, in fact, been early. But you don't see any trend to increasing delay in bring on line units, is that your testimony?

MR. PENN: A. Well, I can certainly agree that's what Mr. Marcus' paper says. If I understand your question correctly, in looking table 1, we have previously testified that the delays in-service for Pickering "B" which you have noted, are very largely associated with steam generator manufacturing problem, a non-reoccurring problem, as far as I'm concerned, and with Darlington, of course, on issues that have been unique.

So I cannot agree with you that there is a systematic increasing trend. And furthermore, of course, the whole purpose of people's efforts in the

world today in the nuclear business, including Ontario Hydro's very substantial studies, are to find appropriate ways to reduce schedules. And I think it's widely accepted that there are very solid ways that can be done.

Q. Indeed, Mr. Penn, we see that if we look at the table, some of your units have, in fact, come on-line earlier than projected. But the overall average for delays from in-service date projections made four years earlier is at the bottom of the page, 7.3 months, which is 1.3 months greater than the six-month figure we just saw in Exhibit 87. You can confirm that, can you?

A. Well, that's what the table says.

Q. All right. If we take the "A" stations out, we get an 11.2 month average delay. Does that look roughly right to you?

A. Well, what the table says to me, for 11.2, is the average of all units after Bruce "A."

Q. That's fine.

A. So that would be Pickering "B," Bruce "B," and Darlington.

Q. And the Darlington numbers, of course, are a little understated here because we don't have Darlington up yet. Whether Mr. Marcus did this

calculation, he assumed in-services that haven't, in fact, been realized, at least for Units 1, 2, and 3. So these numbers are a bit understated for Darlington. You would agree with that?

A. They seem to be, yes.

Q. And within the stations, of course, there's also a subpattern. We see that the first unit is delayed more than the later units, especially the last two seem to generally be brought on-line fairly quickly or with fairly little delay relative to their four-year earlier projections.

A. Well, there's very good reason for that. In order to bring the first unit into service, you have to build all the common services that all four units would share. So, that is one of the reasons. Plus the fact that the people who are building the units can physically look at the first one. And there is improved productivity because of that. Similarly, in commissioning, when you have commissioned one unit, it's a lot easier to commission the subsequent ones.

[12:25 p.m.]

MR. DALY: A. Mr. Mondrow, one point, just to add to what Mr. Penn said, Pickering "B" and Bruce "B" were brought in approximately the same period of time in the mid-80s. And as you will see there,

there is a significant difference between the two, Pickering "B" did have a very specific problem which led to the delays; however, Bruce "B" brought in at roughly the same time period was significantly better.

I agree with Mr. Penn, we are not seeing a generic pattern here that necessarily applies. There were two very specific problems at two stations, but we have a station brought into service at approximately the same time that was significantly better.

Q. Well, Bruce "B" was brought into service with significantly more delay than either of the "A" stations; is that right?

A. Slightly more, yes.

Q. More delay?

A. Yes.

Q. Let's make it without a value judgment.

The trend I see here is that in moving from the "A" series to the "B" series we get a jump in in-service days and we see that trend reinforced in moving from the "B" series to Darlington "A". Do you think that's fair, Mr. Penn? As we move through successive design phases we get jumps, at least in initial units on line?

MR. B. CAMPBELL: Hasn't Mr. Penn already

answered this question? I thought I heard him give quite a lucid answer about all the reasons why he felt it would not be appropriate to take a trend from this number. I thought he dealt with this question.

THE CHAIRMAN: I think he did, yes.

MR. MONDROW: Thank you, Mr. Penn.

DR. CONNELL: I think I missed this exchange, Mr. Mondrow. Did you ask whether the delay in Bruce "B" was significantly greater than the delay in both of the "A" stations?

MR. MONDROW: Dr. Connell, I was responding to a comment from Mr. Daly who pointed out that Pickering "B" and Darlington "A" were special situations, and my response was that with Bruce "B", the one that Mr. Daly pointed to, it in fact was more delayed than either of the "A" stations were.

DR. CONNELL: Could I just ask, Mr. Daly, when you responded to that point, was this based on any statistical evaluation or was it just an impression you were giving?

MR. DALY: No, I accept the figures that Mr. Mondrow has provided here. I was really pointing out the distinction between Bruce "B" and Pickering "B" which came into service at the same time period. So what I was saying was you can't necessarily project

this line, for example, to future plants. There were quite wide differences between plants coming into service at the same time.

We had a specific problem at Pickering "B", we did not have those specific problems at Bruce "B". So we can't necessarily, although there is a line through these, you have to look at the specific reasons, a straight line projection out to the future does not necessarily apply.

DR. CONNELL: My point is, you are not suggesting that the difference between, let us say, between Bruce "A" and Bruce "B" is statistically significant? Obviously the numbers are different but you are not necessarily attributing statistical significance to it. You understand that?

MR. DALY: Yes. I haven't done a statistical calculation between Bruce "A" and Bruce "B".

DR. CONNELL: Thank you.

THE CHAIRMAN: Which was the station that had the steam generating problem?

MR. PENN: Pickering "B", Mr. Chairman. That's the one which had the average delay of 14.8 months.

THE CHAIRMAN: All right.

MR. MONDROW: Q. Mr. Penn, I would like to talk about capital modifications as you have used that term, and that is without - and I always have to pause when I word out this acronym - large scale fuel channel relocation. LSFCR is not included in your capital modifications numbers as you have used them during your testimony; right?

MR. PENN: A. It's replacement. Large scale fuel channel replacement.

Q. Replacement, excuse me.

A. No, we separate it because it's a significant item.

Q. Could you turn to Exhibit 43, please, which is Ontario Hydro's submissions to the Ontario Nuclear Cost Inquiry, to page 169. There is a small table at the upper left-hand corner of that page which gives numbers for capital modification experience, and it is broken out into two subsets, the first is to maintain level of service, and the second is major projects. I guess there is an actually a third sub set which says "other".

Just to confirm again, Mr. Penn, major projects here did not did include the LSFCR work either, did it?

A. No, it's dealt with separately in a

separate chapter.

Q. For the same reasons?

A. Yes.

Q. The remarks on that table, as you can see - well, perhaps you can see, they are rather small - it says low in earlier years, and the converse of that of course is true, that capital modifications expenditures would be higher in later years. Do you agree with that?

A. Not necessarily, no. I think in my direct evidence for the existing nuclear stations we have given extensive information of the forecast capital costs and capital modification costs. And I am referring to a figure on page 67 of Exhibit 519.

Q. So the statement then in the ONCI submissions isn't in fact correct, capital modifications expenditures are not lower in the earlier years?

A. Well, the figure on page 67, reflects what capital modifications have actually occurred since 1975 to the end of 1991. Earlier I gave a listing of what those capital modifications were. They are listed on page 65. If you turn to that you will note that a large number of these capital modifications are what can be described as non-recurring. For example, at

Pickering "A" we extended the size of the heavy water upgrading plant actually so that we could upgrade heavy water from Pickering "B". We put in place a high pressure emergency coolant injection system both at Pickering "A" and Bruce "A". That is a standard design safety system today. So, in other words, in a future plant we wouldn't be expecting to make a capital modification of that nature, and that's going back to figure 24.5, Exhibit 43, is what is being referred to.

Q. Indeed. On the rest of this page mention is made for those backfits that you don't anticipate having to repeat. That comment is made in the second paragraph under item .5. The last sentence of that paragraph, after listing some provisions says:

> These provisions are included in the initial capital cost of Darlington in the future station.

But that statement, notwithstanding in this ONCI submission, the table still says low in earlier years. Are you disagreeing with that then, that's not the case?

A. No, I am not disagreeing with that at all. It is going to be low in earlier years on a future nuclear plant that is a repeat essentially of Darlington.

Q. That means high in later years relative to the early years?

A. Well, higher.

Q. It's a converse.

A. I think you used word "high". I would think it would be more accurate to use the word higher than earlier years.

Q. Higher in later years?

A. Higher in later years compared with earlier years.

Q. Great.

Mr. Penn, has Ontario Hydro done a full scale statistical or probabilistic analysis of capital modification trends?

A. No, we haven't, because we inspect our stations, and of course we make changes to upgrade safety systems and we plan for periods of 10 years.

We looked the other day at the board memo with regard to the Bruce "A" rehabilitation, which is taking place over 10 years.

I don't believe you can logically or consistently use regression analysis or statistical analysis of this type of information to project into the future.

Q. Would you agree then, Mr. Penn, that

the numbers given in ONCI are largely based on judgment, the numbers for the future stations?

A. They are based upon experience in the past, as the figure is titled, capital modification experience, and they are based upon judgment based on engineering knowledge of operating the plants and designing them.

For example, in this particular chapter, I happen to know this because I worked with the author in coming up with some of this, we, for example, assumed that --

Q. I'm sorry, Mr. Penn, where are you looking? I missed your reference.

A. I am talking about Exhibit 43--

Q. Excuse me, I thought you had a particular --

A. --Chapter 24, which was written by G.R. Fanjoy, and I was just going to comment that in the forecast capital modifications for future plant we have allowed for the replacement of one steam generator, for example. Now, we have never had to replace a steam generator but we put it in here for conservative reasons.

Q. Now, when you estimate costs for the third decade, that's certainly pretty well a guess

because you don't have any experience with 30-year old plants; right?

A. It's not a guess. We have many years of experience of operating conventional plant, coal-fired stations, condensers, boilers.

Q. Not the nuclear side, not the nuclear stations, though.

A. Well, we have a great deal of knowledge of the design and the operation in the world of very similar equipment.

I couldn't agree with it being guesswork.

Q. How would you characterize it?

A. I would characterize it as experienced judgment based upon the operation of plant in Ontario and understanding of its design and learning from others elsewhere in the world.

Q. Mr. Penn, are there a lot of plants elsewhere in the world that are over 20 years old?

A. Not many.

Q. So there is much not world experience with reactors over 20 years?

MR. B. CAMPBELL: I am sorry, we are talking nuclear plants, Mr. Mondrow?

MR. MONDROW: Nuclear plants, Mr. Chairman.

MR. PENN: Right quite.

MR. MONDROW: Q. And the operating experience you have is all with your plants that are less than 20 years old, 20 or less?

MR. PENN: A. Our oldest plant at Pickering "A" is in its 21st year.

I might add to this, that this is a matter that's reviewed at the Ontario Energy Board every year. It is part of depreciation of equipment and there is extensive discussion on the life and the state of repair of all major equipment in all nuclear stations and all fossil stations, and hydroelectric for that matter.

Things like dispersion curves are used to predict the sort of thing that you are talking about.

Q. Reading on page 169 on Exhibit 43, in the right-hand column, starting at the 6th bullet, you say -- I'm sorry, we can skip down a little further than that. Starting at 7th bullet it says, during year 30: During year 30 three activities are assumed to occur. You talk about large scale fuel channel replacement, plant retirement unit working, and inspection and maintenance of the remainder of the station.

You say this outage will put the station

in better repair and is expected to result in a capital modification decrease in the fourth decade.

Of course you don't really know what you are going to fine at year 30 when you start to look at the insides of the nuclear station. No has ever done that; right?

A. I think you have the wrong concept. In order to safely and reliably operate a nuclear station, one has to be very familiar with the state of repair of the plant.

Were you referring to inside the reactor core, for example?

Q. I am saying that you don't know exactly what you are going to find at year 30 when you do major maintenance; isn't that fair?

A. I would imagine that we will be surprised to find out something is perhaps more worn through fretting than we expected and we would surprised to find that things are less.

Q. Like the fuel channels elongated more than you thought they would and you had to adjust for that. That occurred in the earlier years and there could be things like that occurring in the later years?

A. No, I don't agree with that.

It's true that when Pickering "A" was

designed, there had been insufficient number of years go by to subject zirconium-2 pressure tubes, to extensive integrated flux. We just hadn't had enough years. This work went on at Chalk River for nearly 20 years, in my knowledge. And after the later reactors were designed to have greater bearing movement in the ends to accommodate the axial elongation.

Q. Yes.

A. In fact, they are designed for 30 years.

Q. Yes, and you have solved that problem, but there could be other problems that occur in older plants. For example, in the United States, embrittlemment is a big problem. It occurs with age. It's occurring as we approach over 20 years, 25 years of operation.

Might you not have problems in the later years of a nuclear reactor that you have no way of anticipating? It is possible; isn't it?

A. Well, it might be.

Q. You don't assume any of that in ONCI. You assume, in fact, that the fourth decade will be cheaper in terms of capital modifications than any of the other decades.

A. For the reason that's stated here,

that we are assuming that we would do at the same time that we replace the fuel channels at year 30, we would take that opportunity to do a very large review of the whole plant.

Q. And you will see what you mean find when you do that. We will all see what you find at year 30 when you do that. Hopefully you will pleasantly surprised.

A. Mr. Mondrow, you seem to think that we go around with our eyes closed for the previous 30 years. The plant is under a state of maintenance and inspection all the time.

Q. I realize that, Mr. Penn. Thank you.

Could you turn to our interrogatory package, please, page 132. This is interrogatory 9.7.111, which I believe, Mr. Chairman, needs an exhibit.

THE REGISTRAR: .131.

---EXHIBIT NO. 520.131: Interrogatory No. 9.7.111.

MR. MONDROW: Q. In the third paragraph of the response, Mr. Penn, it says:

> It is the nature of capital modification costs that they fluctuate significantly from year to year. No long-term trend is apparent.

That would contradict the statement that we saw in the ONCI table, that capital modifications are low in early years; is that right?

MR. PENN: A. Well, I imagine that that third paragraph reflects the curve that we looked at earlier in my direct testimony, which is in Exhibit 519.

Q. In fact, Mr. Penn, there is a curve on page 134 of our page which was the response given to that interrogatory, that was the context of that statement. Indeed, it could be argued that no trend pops out at you from that diagram. You would agree with that, I take it?

A. Yes, I do.

Q. Let's take a closer look at that, if we could.

A. That reflects, I think it reflects the -- well, it obviously does. It reflects the capital modifications that have actually taken place in the existing nuclear system from 1976 to today. I previously mentioned that quite a number of these are non-recurring items.

For example, another one I didn't touch on is the security system around our stations, that was considerably improved.

Now, we don't expect, given that we have now got the best there is, to have to do more in that sort of area.

Q. Sorry, Mr. Penn, are you qualifying the statement given on the cover page in response to that there is no long-term trend?

I hear you to be saying that there were non-recurring events in the early years, and if we take those out will there then be a trend as identified in ONCI?

[12:47 p.m.]

A. I'm saying that I agree with this statement. It is the nature of capital modification costs that they fluctuate significantly from year-to-year.

Q. And there was no long-term trend?

A. No long-term trend is apparent.

Q. That's not what ONCI said, is it? We just saw that. ONCI said that it is low in early years --

A. But ONCI is referring to a future plant that includes things like high pressure ECI systems and up-to-date security systems and the like.

Q. So, if I understand you correctly, you are saying that for future plants it is fair to say

that the ONCI statement is correct, that there is a long-term trend?

THE CHAIRMAN: Well, he doesn't use the word trend. It isn't just referring to trends.

MR. MONDROW: I take your point Mr. Chairman.

MR. CAMPBELL: Not only that, Mr. Chairman, but the comparison that my friend is trying to draw is between something that is identified as the whole nuclear program versus ONCI, which is specifically associated with trying to identify the costs that are appropriate to use for a future station. And in my submission, that is not a comparison on a proper basis.

MR. MONDROW: Q. Mr. Penn, for the costs that you use for a future station, is it fair to say that there is a long-term trend in capital modifications costs?

MR. PENN: A. The model used is in Exhibit 43, page 169, and is given in figure 24.6.

Q. Bear with me for a minute, please. Yes, I have that.

A. It shows it in three categories necessary to maintain level of service.

Q. Sorry, this is the lower figure you

are looking at? Bottom left of the page.

A. Yes, I am looking at the lower figure on the left-hand corner.

Q. Right, I have that.

A. That associated with major projects, other than large scale fuel channel replacement, which is additional to this, and other.

Q. And in the first three --

A. And it is expressed in cents per kilowatthour. And then on figure 24.7, it also gives other data as plant equipment and major spares that will be need over time.

Q. Yes.

A. And then below that table it says what specific equipment is assumed to have to be done at year 10, year 20, and year 30.

Q. Yes. That's what you are pointing out to me?

A. Yes.

Q. What is listed here?

A. Yes.

Q. All right. Looking back at table --

A. So the model is quite clear for what we have assumed.

Q. And do you think that this model

shows a trend to increasing capital modifications costs in later years?

A. Well, I already agreed with you that it was higher in later years than in earlier years.

Q. Great. Turn to page 135 in our interrogatory package, please. That is Interrogatory 9.7.517, which needs a new exhibit number please, Mr. Chairman.

THE REGISTRAR: .132.

---EXHIBIT NO. 520.132: Interrogatory No. 9.7.517.

MR. MONDROW: Q. Turn to the table given in response to that interrogatory, there are two tables which give capital modifications summaries in millions of dollars, the upper table is in dollars of the year and the lower table is in 1990 dollars.

It is the lower that I would like to speak to, please. And Mr. Penn, would you just confirm for me that the numbers in the lower table are updates of the numbers provided in response the interrogatory that we looked at previously which was 9.7.111?

MR. PENN: A. Well, I have to take that subject to check because I don't see that I have any means to confirm that.

Q. I can help you out a little bit, and the reason that I phrased question that way is because

there have been a number of iterations of these numbers. But if you look on the interrogatory cover page, you will see that 9.7.517 in fact updates 9.7.83 which in turn updated 9.7.111. I will just ask you to accept, subject to check, that these are your current numbers for capital modifications costs of the existing system. If you determine otherwise you can advise us. Is that acceptable?

A. Yes. Now, of course in my direct evidence, I gave detailed information also on this subject.

Q. Mr. Chairman, I have referred to 9.7.83 and we should have an exhibit number, please, if appropriate.

THE CHAIRMAN: 9.7.83?

MR. MONDROW: That's in fact referred to in the interrogatory question and answer.

REGISTRAR: What page is that, please?

.133.

---EXHIBIT NO. 520.133: Interrogatory No. 9.7.83.

MR. MONDROW: Thank you.

Q. Back on the table on page 136, there are numbers given for expenditures for capital modifications for Pickering "B" for the years through 1982, but, in fact, that station was not in-service at

that time; is that correct, Mr. Penn?

MR. PENN: A. Are you referring to Bruce "B"?

Q. Or Pickering "B" either station. There are numbers on the table for stations not yet in-service and yet there are capital modifications numbers; is that right?

MR. DALY: A. The first unit at Pickering "B" was put in-service in 1983 and at Bruce "B" in 1985.

Q. So from the years 1976 up to '83 for Pickering "B" and '85 for Bruce "B" there are numbers for capital modifications but those stations weren't in-service, why is that?

A. My understanding of those is there are some common amenities, common buildings which are being put up on-site and which, for accounting purposes, are charged to capital modifications in this way. I don't have many more details, but I gather that is the accounting practice.

Q. If you could turn to our new Exhibit 649, please.

You can see from the precis to this exhibit, first of all, I should say that this exhibit is a short analysis, as you can see from the precis of

the numbers given in 9.7.517 and in fact for the years 1991 through 1993 there are numbers taken from 9.7.85. Which is at page 137 of our interrogatory package and I believe it needs a new exhibit number. It's page 137, Mr. Lucas.

THE REGISTRAR: 137?

MR. MONDROW: Yes. Interrogatory 9.7.85.

REGISTRAR: That will be .134.

MR. MONDROW: Thank you.

---EXHIBIT NO. 520.134: Interrogatory No. 9.7.85.

MR. MONDROW: Q. And you can see from the precis that Mr. Marcus has done two things with the figures in 9.7.517 and 9.7.85. The first is he has used only the costs expended on stations in-service and the purpose of that was to give a consistent basis for comparison with capital modifications projections from elsewhere, including those in ONCI.

The second thing he has done is added the numbers, as I have said from 1991 through 1993 from 9.7.85. The revised totals are given in table two. And the next, I'm sorry, in table 1. Revised totals are given in the table to that exhibit. And the next page plots those revised totals and if you could turn to that plot, please, Mr. Penn.

Would you agree that with those

adjustments that there is somewhat more of a trend apparent here for capital modifications costs.

MR. PENN: A. Well, I think it's fairly obvious that if you lower the front end of a curve that it causes it to be inclined. By which I mean, if you don't include costs then obviously you drop the points.

Q. And if we are talking about capital modifications costs as they are defined, that would be for stations once in-service that would be the trend you would get if you redid the numbers out from 9.7.517 to reflect that, right?

A. Well, the point I have tried to make to you is that Mr. Marcus has stated, right in his abstract of Exhibit 649 that table 1 and figure 1 of 9.7.111 are revised to use -- to (1), use 9.7.517 data, (2), include capital modifications costs only on in-service units which reduces cost shown prior to 1984. So, if you go to this curve and you look at prior to '84, then those figures are lower than they should be.

Q. I can see that, Mr. Penn.

THE CHAIRMAN: We have to stop now until 2:30.

THE REGISTRAR: Please come to order. The hearing will adjourn until 2:30.

---Luncheon recess at 1:00 p.m.

---On resuming at 2:40 p.m.

THE REGISTRAR: Please come to order.

THE CHAIRMAN: We have another exhibit to read into the record. It's exhibit No. 646, filed by the proponent, Ontario Hydro, who was the author of the document, and its title is Panel 10 Supplementary Witness Statement.

---EXHIBIT NO. 646: Panel 10 Supplementary Witness Statement.

MS. HARVIE: Mr. Chairman, sorry to interrupt.

Just while you are on the topic of fillings, I arrived after lunch and was told that the final guidelines for the preparation of environmental impact statement was filed this morning as Exhibit 651 and nobody could recall who the sponsor of the exhibit was.

THE CHAIRMAN: If you read the transcript, I think we are the sponsor of the exhibit. It came in to us through the mail and we thought it was a document that we might share with the parties.

MS. HARVIE: Very good. Thank you.

MR. MONDROW: Thank you, Mr. Chairman.

Q. Mr. Penn, before lunch we were

discussing Exhibit 641 which is the table, we had been discussing different interest rate sensitivities. I just want to ask you one question on this table then. Is it Ontario Hydro's evidence that the Board should rely on the trends indicated on this table in terms of the decisions that they have to make about nuclear, that this is representative?

MR. PENN: A. Those costs represent actual costs for the five nuclear stations operating in Ontario, including capital modifications to date in constant 1991 dollars.

Q. Using 4 per cent --

A. And including for the sake of comparison with other costs in the world, 4 per cent real interest rate.

Q. And for the sake of comparison with the future station, this then is representative in Ontario Hydro's estimation?

A. Well, they use 4 per cent real interest rates as well, so that you can directly compare the costs.

Q. I believe you were trying to indicate a trend here by plotting these various stations to show that the future stations are not out of line, so that then is your position. That's what is indicated by

this graph at 4 per cent interest rate?

A. Yes, it shows that some of the nuclear options that can be considered in the future will be cheaper than Darlington, and some will be slightly more.

Q. Would you rely on the specific numbers indicated on this chart even though they are not equal to the corporate financial discount rate?

A. Well, I have relied on them from the point of view that it states quite clearly that we have assumed a 4 per cent real interest rate, and the purpose of it is to show the trend and be able to compare with the costs of other plants in the world.

Q. Thank you.

Also before the break we were talking Exhibit 649, Mr. Penn, and we had turned to the graph. I had indicated that Mr. Marcus, in his analysis, had taken out the numbers from a source interrogatory which were capital modifications that in fact were made before the units were in-service, and you were commenting that of course if you take number out of the early years, the early year plot goes down.

When you do your capital modifications forecast, when you did them for ONCI, the ONCI submissions, Exhibit 43, were all the capital

modification numbers from an after in-service date? All the projections were projected to be from an after in-service date; is that right?

A. Yes.

Q. So if we wanted to compare your history and your actual experience capital modifications and set those up against your ONCI projects, would it not be appropriate to look at only those numbers that were in fact capital modifications after the in-service date of the existing units?

A. Well, some of the figures that you have removed from the early days of this graph here are very substantial.

Q. Yes, they are. And they would be included --

A. They were actually spent, and as Mr. Daly said what the purpose was.

No, I disagree.

Q. Those figures that we have removed would be included in the capital cost, the initial capital cost for the future facility; is that correct?

A. Yes, they would.

Q. Not in the capital modifications costs?

A. Well, we are assuming that, anyway.

But while we are looking at this graph here, I have noticed in looking at it over lunch that if you would have continued plotting data that was provided in Interrogatory 9.7.85--

Q. 9.7.85.

A. --you would have found that the graph would be reducing with future time. Ontario Hydro provided data right out to beyond the year 2000. And I am referring to data on your page 138 of your interrogatory package.

Q. The further out you go in those projections, the less certain those projections are, and Ontario Hydro admits that; isn't that right?

So the closer years will be a little more certain then the years as you go out.

A. Well, if anything, and it is an interesting point, because we forecast and project capital modifications for 1990 of $267.7 million and we actually did the job for $176.3 million, and that's also brought out in the these interrogatories.

So we believe that we have conservatism in our Hydro forecasts. So I couldn't accept the point you are making about the uncertainty of the future data and that's why you left it out, because it obviously makes a big effect if you then turn around and use

linear regression analysis to project into the future.

Q. The trend that seems apparent on this graph, even with all your caveats, would jibe with the trend identified in ONCI, that in early year capital costs are low relative to later years. That would jibe, wouldn't it?

A. I am just pointing out that you and your client have left out information from the front end of this graph and have totally ignored information at the back end of the graph.

DR. CONNELL: Isn't there another problem, Mr. Penn, that this plots the cost of modifications against calendar year rather than age of unit, so it's difficult, without looking at commissioning dates, to form an impression of what is the early period.

The last commissioning for Bruce "B", was what, '85?

MR. DALY: A little later.

MR. PENN: '86-87?

DR. CONNELL: So at least as far as Bruce "B" is concerned, the early years would extend right up to, I suppose you could say, if you counted the first five years as early year, right up to almost the end of the graph.

MR. PENN: Yes. It's a mixture of data of older and newer plants.

DR. CONNELL: So to read any trend at all would be difficult in this presentation.

MR. PENN: I think so.

MR. DALY: I think, Dr. Connell, there is a later presentation where it is, as I understand it, done by age.

MR. MONDROW: Q. Indeed, Mr. Daly, and perhaps we should move on to that now.

That is Exhibit 650, I believe, which, as you say, Mr. Daly is a regression analysis done by Mr. Marcus of the numbers we have just been speaking of. And the regression analysis of course is based on the age of individual stations, as Dr. Connell has pointed out is a factor in this consideration.

First of all, though, if you just turn to figure 1 of that exhibit, please. You will see that we have plotted the actuals again, this time by years after first unit startup for each of the "A" units and then the "B" units, and then we have plotted the actual projections given in ONCI.

Would you say, Mr. Penn, that there is any trend indicated on that graph?

MR. PENN: A. Well, I would like to

comment on the grafts before we discuss trends and their veracity.

If I look at the curve marked average "B" units, I note from the table on the previous page that the last point at year 10 is a single point of $36 million associated Pickering "B". So it's not an average. And if you look at the averages of the previous years, they are quite a bit lower.

So if would have put in an average for -- if we had an average figure for Bruce "B", I am quite sure it would be significantly lower than what is plotted on this graph.

Q. So the last little bit of that line between the last two plotted points you are saying wouldn't climb as steeply?

A. No. In my view it would be somewhat similar to the point plotted at year 10.

The second point I would note is the dotted line that's average "A" units, that the last spike is entirely due to Pickering "A", and a considerable amount of that money is associated with the nutronic enhancement this shutdown system for Pickering "A"--

Q. Yes.

A. --which is clearly a unique and

isolated circumstance. So, it's not indicative of what you can project into the future for other circumstances.

The third observation I would like to make on the ONCI data is that it says as the source of this information under table 2 at the bottom:

For new plant ONCI report page 169 increased by 8 per cent to 1990 dollars.

And I just wanted to note, looking at ONCI report, Exhibit 43, that there are significant costs associated with plant retirement units on page 170, and we looked at this this morning, and it shows in figure 24.7 the costs projected in millions of dollars at year 1, and then during year 10, during year 20, during year 30.

I just wanted to note that, for example, there is a sum of $400 million there associated of course with replacing reactor building cabling and mainly instrumentation and control systems, and I wondered, looking at this graph here, going out to year 30, it seems to decline rather than show that very considerable expenditure at year 30 predicted for future plants. So I just wanted to make those comments before we then tried to interpret trends.

Q. Mr. Penn, could we turn to figure 2

of the exhibit, please, which is the regression analysis. I would like to focus on the line for Bruce "B" which doesn't seem to have some of these problems that you have just spoken to.

You would agree, I think, that based on this regression plot, if you experienced the same capital modifications expenditures as you have in the past in the future, you will in fact significantly exceed your ONCI predictions for capital modifications?

A. Well, if we did. Now, we have to look at the validity of that line.

As you know, Bruce "B" has only been operating for on average -- Mr. Daly?

MR. DALY: A. I believe 10 years. The Bruce "B" line just includes 10 years of actual information.

MR. PENN: A. So we have here by a linear regression fit of that data, we have an extension of a further 20 years.

I did glance somewhere at the -- I thought somewhere there was an index of fit for the regression analysis. I can't locate it at the moment.

Yes, Mr. Daly is pointing it out to me, on page 2 of your Exhibit 650.

Q. Yes, I have that.

A. I presume that on the right-hand side of those equations, that our R umlaut 2 is the symbols used for mean square fit.

Q. Yes, that's right.

A. And I just indicate from my knowledge of regression analysis, that those indices are very low, showing that the fit of the data is not very dependable.

Q. Have you done a lot of regression analyses, Mr. Penn?

A. Yes, I have.

Q. And it's your position then that these numbers data not a very good fit.

A. Well, my view - and Mr. Daly has a lot of knowledge with this sort of thing as well - My view is that regression analysis is an excellent technique for defining a function, whether it be linear or hyperbola, or whether it be quadratic, or whether be exponential, or whatever, polynomial, of data within the bounds of that data. But to use that technique to extrapolate much beyond the bounds of that data in my view is not very dependable.

THE CHAIRMAN: Not very what, I'm sorry?

MR. PENN: Dependable.

MR. MONDROW: Q. Mr. Penn, I would like

to deal with your concerns one at a time if I could.

The first concern you had, going back to figure 2 here, that Bruce only had 10 years worth of data and was projected outwards. In fact, the Bruce line doesn't look that much different from the overall average line, does it, at the top for which we have a lot more data; is that right?

In fact, if anything, it's somewhat lower.

A. Well, of course, I haven't had time to look at this in great detail, but again the index of fit, as far as I can see, for that data is less than -- maybe you can help me and tell me where to look for it.

Q. It's on page 3.

A. Page 3 at the top of the page, there.

Q. 74 per cent.

A. .74.

Q. Which is 74 per cent.

A. I think it is recognized by mathematicians that a route mean square of anything less about .85 is not very meaningful, and perhaps you ought to be searching for another function.

Q. Mr. Penn, we are just talking about the Bruce "B" equation on page 2 and we see 85 there. You were telling me that's not a good figure either.

A. In my view, it's borderline.

Q. Let me read the sentence after those equations on page 2. It says:

> The trend toward increasing capital modifications costs is apparent for all of Ontario Hydro's existing units with a level of statistical significance exceeding 99 per cent in each of the equations. These equations explain between 71 per cent and 85 per cent of the variation in the data for each station.

Do you agree with that statement?

A. Well, I don't know where the 99 per cent comes from.

Q. If you look on the footnote, you will see where that percentage comes from. The number in parenthesis is a T-statistic:

> A T-statistic greater than about 2.2 is significantly different than zero at 95 per cent confidence level (for the number of observations in question) A T-statistic above 3.2 is significantly different at a 99 per cent confidence level.

You are familiar with regression; is that true, Mr. Penn, in regression analyses?

A. Well, that's certainly what it says there.

Q. Do you have any reason, based on your knowledge of regression analysis to question that explanation?

A. Not particularly. But as I pointed out, this simple linear curve fitting is just grossly extrapolated.

MR. DALY: A. Perhaps I could also add a comment this since, as Mr. Penn says, we have used an evaluated linear regression.

We have used values of R-squared around .8, .85 for doing short-term extrapolations. I would regard as sort of using figures like these as one of a number of checks I might do to extrapolate for the next one to two years.

[3:03 p.m.]

But to extrapolate it 20 years... Earlier on we were discussing in-service dates. And you made a valid point that predicting in-service dates four years ahead of time is one thing, but if you are predicting in-service dates 15 years ahead of time, there's a much wider scope for error. And I think that

equally applies here.

The nature of capital modes is, as your other curves indicate, the nature of capital modes is very variable. And I agree with Mr. Penn, that to extrapolate those figures beyond one to two years, in my view, from what I know about regression analysis, would be very questionable.

Q. So you don't actually project out very far, then, for capital modification subject to the educated judgment we were talking about earlier. You don't do regression for these.

A. Not in this way. With capital modifications, normally in the business planning process we project out 10 years but we don't use linear regression analysis to do it. What we look at is what specific capital modifications do we need for those years. And we presented some of that information to you, and the figures do go up and down. They are quite variable. They don't tend to follow a nice, straight line. So for that reason we don't use regression analysis in forecasting this particular variable.

Q. You just make judgments, as we saw in ONCI, and you can see the ONCI line plotted at the bottom of figure 2. That's the way you handle future projections for capital modifications, right?

MR. PENN: A. No, we don't agree with that. First of all, we inspect our plants to determine what has to be modified or replaced. And then we know from the market the cost of equipment and we estimate the labour necessary to do in considerable detail.

And, of course, we plan on a 10-year basis to do this sort of thing, hopefully using most of the planned outages, and particularly the retubing outages. Now, when it comes to future plant, we have the basis of all the knowledge, information gained from our existing operating plant. So it's not a question of guessing it or just assuming something. There's a basis to it.

Q. You have to give me just a minute, please. Mr. Penn -- I'm sorry. Dr. Connell?

DR. CONNELL: I am just going to raise a problem. Obviously, this graph is not evidence, so there's no need to try to assimilate it. But I just draw attention to something that puzzles me, if I'm reading it correctly.

There are 11 years of Bruce "B" date as shown table 2. And I presume the regression was done on those 11 years. I have just looked at the last six data points for years 6 through 11. And they all lie above the regression line.

In fact, the last four points at years 8, 9, 10, and 11 show a very striking upward trend; the final point being at $36 per kilowatt in year 11.

It just strikes me intuitively that there's something wrong here, that the regression line would lie below six consecutive data points.

MR. MONDROW: Dr. Connell, it may have that we are talking about different columns here. I see the 36 number as the last point under the average for the "B" Units column rather than the Bruce "B" column.

DR. CONNELL: I see. I should be looking at Bruce "B," should I? Oh, yes.

MR. MONDROW: The broken out line is actually the Bruce "B" regression.

DR. CONNELL: I see. So that's the 1914. Okay. I will go back to my plotting then and resume this discussion in a few minutes if need be.

MR. MONDROW: Thank you.

Q. Mr. Penn, you had some concerns about extrapolating data out very far. If you just look at figure 2, the regression plot, just look up to year 11 for which you have actual data, the regression shows that you have significantly diverged in your actual experience from your projections. And even the raw

data significantly diverges from your ONCI projections, right?

MR. PENN: A. Well, I think to really take this argument or discussion further, one really should be looking at what are the activities in the capital modification to Bruce "B" actually performed and determine whether it is reasonable or not to assume that the same types of capital modifications would be performed on a future station for which we would have the benefit of knowing the need and building it into the design.

Q. Have you done that, Mr. Penn?

A. That's been the assumption. And if you go to ONCI document -- yes, if you look at page 169 in the left-hand column, at .5:

> We have removed selected actual capital modifications from the experience data base since they were not applicable. Examples are, (1), the recent back fitting of safety-related capital modifications such as high pressure emergency injection. (2), environmental qualification to ensure operation after potential lost of coolant accident. (3), security provisions, et cetera. These

provisions are included in the initial capital cost of Darlington and the future station.

Q. Those types of expenditures, if there were any, for Bruce "B" were significantly less than for the earlier stations, right? Each of those that you have just listed?

A. I would agree, yes.

Q. So if we look at the Bruce "B" line in our regression analysis which is the station most similar to Darlington, which in turn is most similar to the CANDU "A" project or proposal, this paragraph you've just read would have limited application to that particular regression line; is that right?

A. Well, I wouldn't go as far as agreeing with you on that matter.

Q. It would have some application but less so than for the average of all the stations.

A. I would have to ask Mr. King. I'm not sure of my ground here. But, for example, I imagine we are doing at Bruce "B" some environmental qualification of equipment.

Q. You are doing that now?

A. We will be doing it.

Q. But you haven't done it. It wouldn't

have been in the numbers we have used for this analysis in the past.

A. Well, you may be -- I can't be sure on whether work in that area has already been done at Bruce "B" or is planned for the future. However, my point still stands, that as Mr. Daly said, it's very clear from my direct evidence where we have for the existing nuclear systems given on a year-by-year basis in constant dollars, capital modifications actually spent and those forecast, that it is a very variable cost per annum and doesn't lend itself to concepts of regression analysis to extrapolate how much money you may be spending in 20 years time.

Q. I understand that's your position. Thank you.

DR. WHILLANS: Mr. Mondrow, may I ask for a clarification?

MR. MONDROW: Certainly.

DR. WHILLANS: These are unweighted square regressions?

MR. MONDROW: I'm advised that the answer is yes.

DR. WHILLANS: And are they based on all of the data or just on the averages?

MR. MONDROW: All of the data.

DR. WHILLANS: Thank you.

MR. MONDROW: You are welcome. Perhaps we could move on, gentlemen. Our interrogatory package, please. Page 139, is Interrogatory 8.2.14, which I don't believe has yet received a number.

THE REGISTRAR: That is been previously been identified as 520.82.

MR. MONDROW: Thank you, Mr. Lucas. You can see from the cover page that the report attached in response to this interrogatory is the latest issue of the internal and external man hour and cost comparison for fossil and nuclear projects. I have not copied the whole report. I have copied the title page at page 140 of our package, and I have ever also copied the table of contents.

There are a lot of grafts and figures which I haven't copied. I would like to go to just a few excerpts from the text for some comment, if I could. Just at the executive summary page, please, 142 of our package.

We see from the first sentence there that the purpose of this report is to compare man hour and cost performance on major fossil and nuclear projects both internally and externally.

Q. Is that correct, Mr. Penn?

MR. PENN: A. Yes, this is the EUCG data. That's the Electric Utility Cost Group data, which has about 80 member utilities, mainly from the United States, Canada, and France, Korea.

Q. If we look to the main findings of the study as summarized in the executive summary, one of the two main findings, the first says that most of the graphs show an increasing trend over time for man hours in cost per kilowatt. This increase in trend is the result of escalating regulatory requirements imposed upon the utilities and the extended schedules from many recent projects.

Do you agree with that statement, Mr. Penn, as one of the main findings from this report?

A. The vast majority of the information in this report comes from the United States. And it's certainly true in the United States that there has been escalating regulatory requirements.

Q. And that hasn't happened in Canada, Mr. Penn?

A. Well, I have got the report here. I would have to turn up the data so we can look at it.

Q. In fact, if you turn on page 143 of our package, you will see the internal comparisons. That would be just Ontario Hydro facilities, is that

correct, Mr. Penn? That's what internal comparisons are in this context?

A. Yes.

Q. If we look at some of the observations that can be made, near the middle of page there's that sentence, and then we see paragraph A. It says, Increasing total man-hours per kilowatt on successive projects generally reflect the expending effort required to meet more stringent quality control and regulatory requirements. So that's true in Ontario as well as in the United States, isn't it, Mr. Penn?

A. Yes, but not to the same extent. You know, I showed this graph, this information earlier during cross-examination. And, of course, we have looked at the cost increase, which in real terms it 2 per cent per annum. These are some of the reasons for this increase over time.

Q. If we look at the next sentence there, it says, this time trend becomes more obvious when the comparison is made between "similar" stations built in different time periods, i.e., comparing Pickering "A" to Pickering "B," Bruce "A" to Bruce "B" and either Bruce plant to Darlington."

I'm not 100 per cent sure what the word "similar" means in that context. But from the

comments in the brackets, I would take that to mean that as we move to successive designs, in essence, of your facilities, we get jumps in some of the key variables. Earlier I put some lead time data to you and here we are talking about worker hours and costs. Is that fair?

[3:20 p.m.]

A. Well, I think it is a somewhat generalized statement because -- and I have forgotten the exhibit number that we started to do with, my graph, if anyone...

MS. HARVIE: 641.

MR. MONDROW: Q. This is the one with the dry capital costs at 4 per cent?

MR. PENN: A. Yes.

Q. 641.

A. The only reason I wanted to refer to Exhibit 461, for example if you compare the constant dollar cost in December 1991 dollars per kilowatt between Bruce "A" and Bruce "B", for example, separated by some seven years or eight years of midpoint of in-service, you can see that the increased trend there is rather small. Whereas, if you look at Pickering "A" and Pickering B, the trend is much greater for the reasons that we discussed this morning, that Pickering

"B" was delayed two years while we remanufactured steam generators, and was further delayed a year for a planned purpose.

So while I think the statement on page 143 of your exhibit --

Q. Excuse me, Mr. Penn, this isn't my exhibit. This is an Ontario document.

A. Interrogatory 8.2.14--

Q. Thank you.

A. --as I said before, is a general statement which is generally true, but there are exceptions.

Q. One more question here, Mr. Penn, please.

Second paragraph tells us that:

> The numbers for operating stations do include some additional retrofit work orders, excluding major retubing, as shown in this report. This was done because most of these retrofits are a result of upgraded safety requirements that are incorporated into the design of newer plants.

A. I'm sorry, where are you reading from? I haven't found it yet.

Q. Second paragraph.

A. I have got it.

Q. I will just give you a second to catch up, I am going onto the third sentence, which reads:

> And so in order to make a comparison between comparable plants, cost in man hour data pertaining to these modifications are included with the operating plants.

A. Yes, that's what I said earlier, that these costs--

Q. I have a question.

A. --include capital modifications.

Q. Yes. I have a question coming up, I am just formulating it.

It would seem to me that if you are trying to trace, between successive stations, regulatory trends, you might want to look at the numbers without compensating for these regulatory additions that you have to fit as you move through successive stations; wouldn't that be fair?

If you are trying to trace regulatory, changes you wouldn't want to compensate for the very thing that you are trying to trace.

A. Well, the full report includes data for both.

If you go to the full report, for example, it gives in tabular form, let's take --

Q. Just before we do that, Mr. Penn, I am happy to do, but the sentence I read says this was done because most of these retrofits are a result of upgraded safety requirements that are incorporated into the design of newer plants, which I read to mean that as you go with your next plant to the AECB, you have got additional safety requirements and your additional expenditures, many of them attributable to those safety requirements. That's what this says, isn't it?

A. I am afraid I don't follow your logic.

The upgrade in safety requirements has been mainly required by the "A" stations. As time has gone on, and certainly for any future station, we have all the benefit and knowledge of what is necessary in this special safety systems. For example, we know what sort of security system is necessary, rather than what was in place, for example, at Pickering "A" when it was first built.

Q. So you are telling me that there aren't very many of these retrofits on Bruce "B", they

are mostly on the "A" stations?

A. Well, if you would like me to give you a chance, I can tell you exactly what they are.

Q. I don't want to know right now, Mr. Penn.

A. No, I know you don't. You just like to make suggestions and not allow me to answer them.

Q. If that's the way you like to answer them, proceed.

A. The modifications done so far on Bruce "B" are to site security.

Q. Could you give me the numbers for those if you have them while you are going through, please.

A. $16.64 million.

Q. You don't have dollars per kilowatt there, I take it.

A. Yes.

Q. Could I have those numbers?

A. 4.73 dollars per kilowatt, evaluated the 31st of December 1990.

Q. Are there others that you were going to refer me to?

A. Yes. Now if you want to go through Pickering "A", we can through pages of it.

Q. No, I don't want to go through Pickering "A". My questions was --

A. Bruce "B" clean up, $63.71 million who are 17.17 dollars per kilowatt; site security clean up, 1.102 million or .31 dollars per kilowatt.

Q. Mr. Penn, do you by any chance, to save some time here, have the total for Bruce "B" in dollars per kilowatt as opposed to the total for Pickering "A" -- or Bruce "A"? That might save us some time.

A. Now, do you want it with or without capital modifications?

Q. If you have both numbers, then why don't we take them both.

A. Without capital modifications, 1,986.6 dollars per kilowatt.

Q. For?

A. For Bruce "B".

With modifications done as of January 1991, 2,008.90 dollars per kilowatt.

Q. I am going to try to get an answer to my general question and maybe you don't feel it's appropriate to answer, and that's fine, you can say that.

The initial question that I asked was:

If one wanted to look at the changes in capital costs attributable to regulatory changes as you went through each successive station, you wouldn't want to cancel them out as this exhibit seems to have done as indicated by the paragraph that I read on page 143 of our excerpt. And your response was -- first all, let me pause there.

Is that a fair statement?

A. No.

Q. And your response to that was?

A. You mean why do I think it's not --

Q. A fair statement, yes.

A. Well, if you want to come to grips with what the costs are of regulatory change over time, you have to look at the detailed design of each plant and look at the detailed breakdown of the costs, if you can disaggregate the safety equipment itself.

The capital modifications while important and still costing a lot of money, are a small part of this subject.

All I was trying to indicate to you, Mr. Mondrow, is that the report from which you have taken excerpts gives detailed information with and without. So we have got, Hydro has the information and I believe the full exhibit is already on record at this hearing.

MR. MONDROW: Mr. Chairman, now might be a good time for the break.

THE CHAIRMAN: All right. We will break for 15 minutes.

THE REGISTRAR: Please come to order. This hearing will recess for 15 minutes.

---Recess at 3:30 p.m.

---On resuming at 3:50 p.m.

THE CHAIRMAN: Mr. Mondrow?

MR. MONDROW: Thank you, Mr. Chairman.

Q. Mr. Penn, before the break I thought I heard I say a couple of times that historically you have experienced about a 2 per cent capital cost escalation by in-service year; is it that right? Is that what you are said?

MR. PENN: A. Yes, and I was referring to a figure that's in Interrogatory 8.2.14, and which I showed on the projector. I can tell you it's given on figure -- it doesn't have a figure number. It's the last graph, anyway, in the section of this report that you have just been questioning me about, the internal comparison nuclear projects.

Q. I thought I heard you tell Mr. Poch a little while ago that for the future, if you wanted a rule of thumb for different in-service years, he could

just escalate by 1 per cent a year.

A. No. I was talking there, Mr. Mondrow, about levelized unit energy cost.

What I said is a rule of thumb for a nuclear plant.

Q. Yes.

A. That if you had the levelized unit energy cost for say the year 2005 in-service and he wanted to know approximately but to reasonable accuracy what it would be if you had it in-service in 2010 but different change anything else, then you would multiply your levelized unit energy costs of 2005 by 1.05, or 1 per cent per annum.

Q. So your historical experience has been 2 per cent, but for the purposes you suggested with Mr. Poch you would use 1 per cent?

A. Well, we are talking about two different things.

I said it's gone up in real terms by 2 per cent and in terms of dollars per kilowatt--

Q. Yes.

A. --capital cost.

Q. Yes.

A. What I was talking with Mr. Poch about was the lifetime cost expressed as levelized unit

energy costs, that embraces, as you know, all costs including capital costs.

Q. Capital cost is about 60 per cent of the LUEC; is that right?

A. Yes, it is.

Q. Thank you.

Mr. Daly, a lot of people have touched on this point, and I am not going to spend a lot of time on it repeating, but you would agree, I think, that capacity factors are crucial to costing nuclear facilities.

MR. DALY: A. I agree.

Q. That's because they have got high fixed costs. Most of their costs are fixed rather than variable.

A. Most of their costs are fixed, yes.

Q. That is a better way to put it.

A. Yes.

Q. If you open up your overhead exhibit, 519, please to page 27.

A. That's the world lifetime comparison table?

Q. That's right, sir. And in your direct evidence I believe you told us that these numbers are weighted by year. Could you explain that

weighting, please?

A. Well, when I refer to weighting, I normally refer to weighting by unit size. So for example, the Ontario Hydro figure would not just be an arithmetic average of the Ontario Hydro units; it would be weighted by relative size of the units.

Could you point me, if I did say years, could you point me to the...

Q. Sure, I will. As a matter of fact, I will take to you it first and then we can discuss it. It's Volume 121, your direct evidence at page 21182.

A. Sorry, could you repeat the page number, please?

Q. 21182.

A. Right, I have that. And there I indicate that it was weighted by unit size, as I have just described, and by lifetime years. So --

Q. That's at line 10, just for the record.

A. Yes, lines 10 and 11. So a unit that had been in operation for one year would be weighted at a 10th of a unit that had been in operation 10 years.

Q. And the purpose of that of course is to compare comparable years for the CANDUs with the other times of reactors around the world.

A. That's right, to compare them all on a consistent basis recognizing that some units have operated longer than others. But just to put them all on a consistent basis.

Q. In doing that analysis, that weighting analysis, did you find that your system as a whole was among the younger of the nuclear systems that you compared to, on average?

A. No, I wouldn't say that. As you pointed out, there are not many plants in the world with units older than 20 years, like many of the U.S. plants, older plants are around 20 years. So I didn't find that we were relatively young.

We have some units, Pickering, which is as old as many of the U.S. plants, so we were not at either extreme.

Q. And that would be true on an average, the average of your system is about the same age as the averages of the other systems, the comparison systems.

A. I don't believe we have done that exact calculation.

My judgment would be that it wouldn't be much different because all major countries, France, U.S., Germany, Britain, all got into nuclear power at roughly the same time. And those countries that have a

substantial number of units have been bringing them in on a progressive basis. So I would expect to find we were somewhere in the middle of the range.

Q. Could you turn back one page to page 26 of Exhibit 519. This is the annual capacity factors of Hydro versus world pressurized water and boiling water reactors, 1973 to 1991. I take it that this graph is not weighted by in-service year as the table on the following page is; is that right?

A. That's correct. This is just the annual figures for the particular years shown.

Q. If you could turn to our Exhibit 647, please, page 16, which is the last page.

Do you have that?

A. I have that.

Q. You gathered some data on world nuclear plants and we have plotted, and you see there is two plots here, an actual and a trend line by in-service year, plotted against annual capacity factors. I am not going to ask you to confirm the precise values on the table, but if you plotted your graph at Exhibit 519, page 26, in this way, if you plotted by in-service year, annual capacity factors world-wide, would you expect to find a trend like that, that shows it declines as the units age?

A. We would find a trend somewhat like this. I don't know the exact basis on which this was produced, particularly I would like to know how the trend line was plotted, for example. There wasn't any information provided. It would be helpful to know how the trend line was noted. I take that to be some sort of averaging process, perhaps an average over a number of years. It wasn't clear to us how the trend line was plotted.

Q. Perhaps -- I'm sorry.

A. But with that proviso, the shape of the curve is generally consistent with our knowledge of world performance; however, I should point out that it reflects a very small number of units post about year 18. So the statistics, as you can see, the statistics from that drop from year 19 to 20, for example, such a precipitous drop probably indicates there is a fairly number of units in that sample.

Q. Or there is a large number of units but they were all dropping, it could be either way.

A. It could be either way. But I think there are not that many plants of that age. There are a much larger number of plants that are in the younger years.

[4:00 p.m.]

Q. Yes.

A. So the statistics become less good the farther out you go.

Q. Yes. I would accept that.

A. We have plotted our CANDU units on a similar basis. And, of course, with the CANDU units we have a retubing period. And at mid-life, and, for example, Pickering Units 1, 2, and 3 have recently gone through their retubing and so we have a downward -- the CANDU units have sort of a downward period during retubing, and to date, they have recovered to 75 per cent. So in that, CANDU the reactors are somewhat different because of the mid-life retubing to a typical PWR.

Q. You haven't done a trend analysis by in-service year for world reactors, have you?

A. We have Nuclear Engineering International periodically do one. And in the past we have compared some of our trends with those trends from Nuclear Engineering International -- and your chart here is similar to that types of chart produced by Nuclear Engineering. I don't know. Was that the source of this?

Q. There were various sources. We can provide that if it's helpful. I'm afraid I don't know

that offhand.

DR. CONNELL: I think it probably would be helpful to have the back-up data with us if it's available.

MR. MONDROW: Okay, Dr. Connell.

MR. DALY: And I would also point out that this is a an trend. There are some utilities, some plants with better performance, others with poorer. It's an average of a very, probably around 300 reactors.

MR. MONDROW: Q. And in fact, Mr. Daly, you expect your plants to come back up in terms of capacity factor from now on. So that would be inconsistent with this kind of a trend.

MR. DALY: A. It would be inconsistent?

Q. This trend shows me, and even if we go out to year 19, as you suggested, there is a shallow downward trend here in terms of capacity factor.

A. What you have got out at this period of time is only the initial units that were put in place around the world. And, you know, these were the lead units from particular countries. And, you know, you would expect with lead units that you would have problems and surprises. And as you learn from those, the later units that you put in place would benefit

from that.

I think that's what is partially pushing up the front end of the curve, that the younger units learning from the older units are coming in with better performance.

Q. Mr. Daly, is it Ontario Hydro's position that nuclear OM&A has gone, and will continue to go, up due to tightening regulation?

A. Mr. Penn presented our position in his direct evidence, and that is the -- I can only refer you to Exhibit 519 where he provided our current projection.

Q. And would tightening regulation be, well, perhaps we should turn that up first.

MR. PENN: A. Yes, I presented the actual cost --

MR. MONDROW: I'm sorry, Mr. Penn. Could I have the page number, please?

MR. PENN: A. Yes, I presented the actual costs on page 69 between 1974 and 1991. And the following page, 70, gives the forecast. And as I noted under examination earlier, that we have assumed the upper line trend of the shaded portion in projecting the overall costs in our direct evidence.

Q. And if I recall, your upper line

trend is plus 1 per cent per year.

A. Per year, yes. In constant dollars.

Q. And does that reflect tightening regulation?

A. It's a judgment that, you will notice, that as Mr. Daly gave in evidence, that from 1987 we significantly increased the OM&A costs. And it's our judgment that they will generally trend up reflecting, likely, that the plant needs more maintenance as time goes on.

Q. So then it wouldn't reflect tightening regulation; it would be reflect the need for additional maintenance as the systems age.

A. Well, it reflects our view, our judgment of the fact that as the plants go longer into the future that we will need to spend more money in operating them for all reasons, including regulation.

Q. Including regulation.

A. Yes.

MR. DALY: A. Perhaps I could just, while Mr. Penn is thinking there, is add point, well, two points, perhaps. One, the regulations in a number of cases lead to an impact on capital or capital modifications. For example, the emergency cooling system modifications, that would show up in capital

modifications. So you can find it in either modifications or capital.

And you were questioning whether tighter regulations led to increased costs, that's not necessarily so because if tighter regulations are at the same time driving higher standards of performance, then maybe you need to put up some up front money to put the modification in.

But if the standards are being well designed and implemented, then in the long run that should lead to a higher standard and be of benefit all around.

Q. Mr. Penn, I understand you to have just said that included in your judgment about the 1 per cent annual increase is some factor for tightening regulation. I was looking in your ONCI submissions, Exhibit 43, and I didn't find any mention of future OM&A cost factor due to tightening regulations. Is there one in there that you know of?

MR. PENN: A. Well, before I try to answer that, what I was trying to say to you is that regulation change in the future is only one of many reasons why there will be a relatively modest increase of 1 per cent per annum in real terms in the future.

At least we are taking the prudent view

and, therefore, the conservative view that this will happen. There is also arguments of why it might go down. And that's why we showed the range, to illustrate that. I don't know whether perhaps Mr. King would like to comment on how he sees regulatory change in the future.

Q. Well, first could I just get your answer to the ONCI question. Did you account for regulatory change in your OM&A predictions for your ONCI submissions? Do you recall that?

A. Well, we certainly did in the capital costs because I wrote that part. I didn't write the part on OM&A. So without reading Exhibit 43 in that area. And I thought, perhaps, that Mr. Daly can quickly catch that. I can't answer the question.

MR. DALY: A. My recollection is that it was mainly an influence in the capital area. That's as far as my recollection goes.

Q. Thank you. Mr. King, did you have something?

MR. KING: A. If I could comment, just my judgment as to what would be the rate of regulatory changes, and I'm talking about Atomic Energy Control Board as that sort of regulatory changes in the future. I think the whole regulatory environment is maturing

such that the rate of change of new requirements that are being laid down is decreasing with time, which reflects the maturing of the regulatory side of the business.

So if we are talking about a new plant in the future, I don't see that new regulatory changes are going to be coming along frequently or as frequently as they have been coming along in the past.

MR. DALY: A. Mr. Mondrow, I would just add one point. In ONCI at page 192, this is the chapter on OM&A, on the right-hand side, paragraph two there, there's reference to installation and testing of modifications and preventive maintenance. Some of that, particularly the installation and testing of modifications would be modifications required for regulatory reasons. So there is that.

It doesn't directly mention regulatory in that paragraph, but some of the required installation and testing and ongoing maintenance is related to regulatory-induced modifications.

Q. And that portion, Mr. Daly, is discussing the impact of the budget restraint in terms of your past history. It's not talking about future projections, right?

A. Well, it goes on to describe the

situation we find ourselves in. We have discussed the nuclear hiring program and Mr. Penn's overhead on page 70 where you see the fairly steep increase to restore and maintain good performance.

Part of that is getting the appropriate operating and maintenance effort in. And some of that maintenance effort would be required for ongoing maintenance on changes that have come out of regulations. So I guess in summary, I can't find anything that specifically says regulatory, but there is an indirect impact through the maintenance requirements on those modifications.

Q. Yes. There's and explanation of your past maintenance experience. I was asking about projections for the future.

A. Well, projections for the future did, as we go on in chapter 27, projects from the Bruce "A," Bruce "B," and Darlington, OM&A experienced through to the future station, and there was, at the time of ONCI it was recognized that we were in a catch-up situation on the existing stations and we had to put in that additional effort as shown in Mr. Penn's overhead.

Q. Okay. Could we turn up Exhibit 521, please. This is an exhibit filed a few weeks ago by IPPSO. It's title is Evaluating the Premature

Retirement of Nuclear Facilities; a Case Study. You will see that the author of this exhibit is a regulatory program specialist with the California Public Utilities Commission. I am going to come back to this paper, as a whole, a little bit later. But I would like to just put to you a couple of excerpts, Mr. Daly, from this paper in the context of OM&A.

[4:15 p.m.]

If you could turn to the first page of the paper. I think the tone is set pretty firmly in the first sentence there. It says:

> Counter to prevailing thought, nuclear power plants are quite expensive to operate.

Would you agree with that statement, Mr. Daly?

A. I have problems with general statements like that. Quite expensive relative to what?

I think we have presented our costs and this Board can compare them with fossil costs, and Mr. Penn has provided some comparisons. So I think specific comparisons with other methods of producing power are more informative than a general statement like this.

Q. If we go on and read then it says:

Although their fuel costs are relatively low, nuclear facilities have considerable maintenance and capital requirements compared to most alternatives such as coal and gas.

Would you agree then with that statement, Mr. Daly?

A. I have no experience in coal or gas costs, so I can't comment on it really.

MR. PENN: A. I would be surprised if Panel 8 hadn't already told you that to fit scrubbers on our 500 megawatt units costs typically $300 million each, and selective catalytic reduction is about the same amount of money. In fact, Hydro is spending a lot of money on environmental controls in the future.

I think this is a very general statement.

Maybe there is something very specific to the environment in which this study was done for the San Onofre plant that caused the author to start off with that paragraph.

Q. Mr. Daly, could you turn to page 6 of the document, please. You can look at an excerpt here specifically about the operating and maintenance costs, starting at the first sentence.

Compared to other types of power plants, nuclear facilities require large numbers of personnel to operate and have extensive maintenance requirements. The annual operation an maintenance costs for a nuclear plant can be as much as 10 times that of a comparably-sized gas or coal facility.

Would you agree with that statement, Mr. Daly?

MR. DALY: A. Again, I am not familiar with gas or coal facility OM&A costs.

I think when you are looking at costs you get a better picture by looking at total costs, look at OM&A costs, capital costs fuel costs. Perhaps OM&A is higher but fuel is lower.

What is really important is the total cost over the life of the plant.

Q. Part of that statement that says nuclear facilities require large numbers of personnel to operate, would you agree with that part of the statement?

A. Well, they do require large numbers. Pickering -- let's take a four-unit station, it would require about 1,000 people.

Q. You have just hired 1,000 extra nuclear staff and sent them to Bruce; is that right?

A. Are you referring to some specific document or...

Q. I thought I heard in your direct evidence that you have beefed up your personnel resources and have hired 1,000 more people.

A. Yes, I certainly said that. I don't recall saying a figure of 1,000 exactly.

But I did make reference to the nuclear hiring board memo back in 1988 where we did seek approval for, I believe, it was about 750 additional staff for the purposes of completing the retubing on Pickering 3 and 4, bringing Darlington 3 and 4 into service and for a general catch-up on maintenance.

Q. Shortages of trained operating staff has been a constraint to some of your operations in the past. We discussed that earlier. That's correct?

A. That's correct. And I guess our original estimates of how many people we require to run large multi-unit stations were somewhat off, and we found, particularly as we got into the mid-80s, we found that we did in fact require a higher number of staff to run the stations at the levels we wanted to run them at, and that led to the nuclear hiring memo,

board memo in 1988 and the subsequent increase in staff over the next two to three years.

Q. If we could go back to page 6.

A. Again, I would point out, I believe Mr. Penn has testified to this, that our staffing levels are still relatively low compared to the U.S. So we still do get a significant economy of scale from the multi-unit concept, however, not as much as we had originally anticipated in the 70s, but still a significant economy of scale.

Q. If we could look then at the last sentence of the first paragraph.

In addition, the O&M costs of nuclear plants in the U.S. have historically increased at rate well above the rate of inflation.

First of all, Mr. Daly, is it your understanding that that's in fact the case in the United States?

A. I am not sure about the total length of time that this has been applied in the States. Certainly, after Three Mile Island, costs escalated in the States, and I believe Mr. Penn introduced some evidence on that earlier.

Q. Do you know what the rate of

historical increase would be in the United States for any periods you may be familiar with?

A. I am afraid I don't.

Q. If you could turn to page 7, please, of the paper. Look at the last paragraph, it starts with the word "however", it says:

> SCE - that's Southern California Edison - as I am sure you know - had failed to account for a significant increase in the need for repairs of broken and worn equipment as the plant had aged.

Now, you have given some testimony, Mr. Daly, on the analysis you are doing of the various sub systems to break out the components of aging, but would you agree with age components need additional maintenance?

A. Some components certainly do. Other components, for example, the pressure tubes require major retubing, but thereafter it could be expected to run for many years problem-free.

So, it varies from equipment to equipment, but certainly it's something that you have to keep on top of all the time.

Q. Mr. Daly, you have just said that the

economies of scales that you afforded because of the multi-unit configuration mean that you hope you can keep your costs below those in the U.S.

Are there any reasons that you can give me why you feel comfortable with your projections for future OM&A which are considerably below United States projections or experience, for that matter?

A. Well, maybe Mr. Penn will want to add to this, but my understanding of the situation in the States is there is a very broad range within the States, so it makes comparison somewhat difficult.

We have on-power fueling which I think is a positive feature of the CANDU.

Q. From an operations and maintenance cost perspective?

A. Yes, I would say so.

We have an experienced work-force, we have over 200 years of operating experience.

Q. Just to pause there for a second. the United States has that as well, right? They have as much experience as you have.

A. Some utilities have.

Q. Yes.

A. I would generally characterize Ontario Hydro as an experienced utility, and our plants

have been brought in at different periods of time. So as we have indicated in our evidence we have had problems in shutdowns and performance decline with the "A" stations that we were working on, but I think part of our confidence on the future is that because our plants are similar in design and similar in the way they are operated, we do gain a lot of knowledge and experience and benefit from these lead stations.

And it's true of most technologies, the first motor cars, the first airplanes had problems, but the later cars and planes developed and benefited from that. I don't think nuclear power is any different. We are going to learn from the faults and problems of the earlier plants, and all things being equal you would expect to have progress and improve, and standardization is important in that. Standardization means you don't have to keep solving new problems.

As I said yesterday, common problems also have common solutions, so having solved the problem for one plant, if your design is the same, then by and large you have got that problem solved for many plants.

Q. So then if you built a CANDU 3 or a CANDU 6 or a CANDU 9 you couldn't really rely on that, could you?

A. To some extent yes, because there are

quite a number of similarities between the CANDU 3, 6 and 9 to our plants.

Also, CANDU 6 we can draw on the experience of New Brunswick Power and the other CANDU 6 users around the world, and we do, in fact, do that on a continuous basis.

So there is a lot we can learn from the experience that we already have under our belt.

Q. You referred us to page 70 of Exhibit 519.

MR. PENN: A. The only thing, Mr. Mondrow, I could add is that there is a very significant variation in OM&A costs in different U.S. utilities. Some of the smaller utilities that perhaps have one or two nuclear units have high, very high costs. A company like Duke Power with a fairly significant nuclear program and one of the best utilities in the U.S. has costs not too dissimilar to ours. So it's very variable.

I am not at all surprised that there would be a statement in here that says OM&A costs in the U.S. have historically increased at a rate well above the rate of inflation. I am sure there are examples of that in some utilities.

MR. KING: A. If I could add?

Q. Before you do, I am happy to hear your comments.

But Mr. Penn, though, then I take it you are -- well, you will correct me if I am wrong. I think I am hearing you say that while that historical rate of increase above inflation might be true and in fact probably is true, in some cases as an average you are not sure that that's true.

MR. PENN: A. I don't really know for sure. I am remembering graphs that I have seen that gives OM&A costs of U.S. utilities that don't have significant resources, and they are high.

The range of OM&A costs between different U.S. utilities is quite considerable.

Q. Have you seen any graphs of the average?

A. Of the average?

Q. The average of all the individual experiences?

A. I imagine I have.

Q. You don't recall if the average was above the rate of inflation?

A. No, I don't recall that. No.

Q. Mr. King?

MR. KING: A. Since we are talking about

the United States situation, I thought it would be useful to recognize, I believe there is something in the order of 105 operating power reactors in the United States right now, and they are owned by, I believe, approximately 50 utilities. So the average is about each utility having two reactors, and the inefficiencies caused by having that sort of situation compared to Ontario Hydro's situation, I think you have to recognize that.

The second point I wanted to make is that on the regulatory situation it's quite a bit different there and here. It's a much more legal-based regulatory system with all the inherent costs that are associated with that type of system.

Q. You don't believe then, Mr. King, that the regulatory system in the future in Canada would mirror developments along the lines that the regulatory system in the U.S. has taken?

A. Sorry, you are asking me if I think that --

Q. If you believe that in Canada the regulatory system will develop along the lines that you have just spoken about, that the U.S. regulatory system has taken?

A. With its high legal characteristic,

no, I do not believe it will trend that way.

Q. You do not believe it will trend that way?

A. Typically, in a licencing environment in a utility in United States, you have several lawyers on staff and everything is done in a legal environment. It's not done that way in Canada or in several other regulatory environments around the world.

Q. Could we look at page 70, please, of Exhibit 519. You talked about this graph a few minutes ago. And as you say -- I am not sure if you said this, but I put to you that there doesn't seem to be a trend apparent here, not a smooth trend anyway, pre-1991. You would agree with that I take it?

MR. PENN: A. Well, it's not smooth, but the total unit energy cost in cents per kilowatthour -- I am on page 73, are you on --

Q. No, I am on page 70.

A. Thank you very much.

Q. That would make a difference, I am sure.

A. My comments would hardly be applicable.

Q. I just asked simply, we don't see a smooth trend pre-1991. There is a lot of vacillation

there. You have testified to that and the reasons for that.

A. Yes. And it shows where we had budget restraints which accounts for the drop over a period of time and it shows the increase that's taken place in the last few years.

Q. I have heard you testify to budget restraints a number of times but I don't recall hearing exactly what those restraints were. Could you tell us what they were?

A. Well, I don't know if Mr. Daly knows a bit more about this in the operating side.

MR. DALY: A. Perhaps I could add one remark here, because you were asking a little earlier for some comparisons with the United States. In Interrogatory 9.2.73 - and I don't think you need to look it up - but that particular interrogatory contains the nuclear operations hiring program board memo that I talked about, and in there are some comparisons with the U.S. Now they are only up to about 1985, but they do show the post TMI trends.

Also in that particular interrogatory there is quite a bit of description of the reasons for the budget restraint and the impact it had, and then it leads to this as a justification for the nuclear hiring

program.

So I think there is a pretty comprehensive description in that interrogatory.

Q. I remember looking at that interrogatory about budget restraints and I am not clear exactly what the cause was. Can you briefly explain to us what the cause was of the budget restraints?

A. Well, there was a number of factors. Money was tight at that particular time, also the plants were performing extremely well. Many of the "A" plants during the early 80s were amongst the top, and in fact the top plant in the world for a number of years.

So on the surface with tight money and excellent performance, it was difficult to justify increased funding, although it was apparent to the people in the division at the time that maintenance backlogs were increasing and what you might call the precursors to poor or declining performance were starting to be put in place and these backlogs were growing, however, we were unable to make a sufficiently good case to get increased funding at that time.

However, come 1988 it was clearer that the backlogs had increased, performance had actually

started to decline, the case was clearer and it was approved by the board of directors at that time.

[4:35 p.m.]

Q. You say, Mr. Daly, that the plants were performing well, maintenance backlogs were increasing, but because of the good performance you could not get more money to do your maintenance, right? You couldn't justify it.

A. That was one factor, right.

Q. Right. And the other factor you mentioned was money was tight at the time.

A. That was another factor, yes.

Q. We see a big dip here in the OM&A expenditures around 1982-83, which was the time that you started to spend a lot of money doing the retubing, right?

A. Retubing didn't start until, well, the units didn't go down until late '83. And since it was unplanned, the work really didn't get under way in earnest until 1984.

Q. So it was the last part of that trough there that would coincide with the retubing work.

MR. PENN: A. Anyway, most of the cost of retubing was capitalized.

Q. Yes. But the retubing work would have necessitated, when it was carried out, a lot of reallocation of staff and available funds, right, to do that work? That would have contributed to the tightness of your OM&A budget.

MR. DALY: A. Yes, it did contribute in the retubing years because the retubing part of it is carried out by design construction and part carried out by operations. And certainly for a number of the early years, operations was very tightly squeezed. You will also recall that during that period we were simultaneously commissioning the Pickering "B" station. So were commissioning Pickering "B," we were retubing Pickering 1 and 2, and we had significant maintenance backlogs. So there was a fairly significant total stress on the station at that time.

Q. If you could pull out Exhibit 537, please. This is a one-page graph filed by Mr. Heintzman. At the same time, perhaps you could pull out Volume 124 of the transcript. So we have Exhibit 537 and Volume 124 of the transcript. And if you could open the transcript to page 21659.

A. Yes, I have that.

Q. In the discussion there in the transcript, Mr. Daly, you were reluctant to confirm a

correlation between OM&A declines and capacity factor declines. You can see actually at page 21660, starting at line 3, you say:

I think you know to get a full correlation you have to look at all the factors behind both curves. And while I would agree that the capacity factors started dropping off at the time that the budget restraints started to come in, we, as I say, started shortly to get into pressure tube problems. So to get a full correlation, you have to look at all the factors.

Mr. Daly, I would suggest to you, looking at Exhibits 537, that the correlation that's apparent there is, in fact, caused by the common cause of the pressure tube work that you had to do. The pressure tube outages, of course, lowered capacity factors. And I would put to you that the additional expenditures also necessarily imposed budget restraints on your OM&A. Would you accept that?

A. No, I don't accept that. As Mr. Penn has said, the retubing was primarily capital. At most, I would say it was, you know, a contributing factor. But I couldn't agree with your hypothesis.

Q. Even though the retubing expenditures were primarily capital expenditures, that would still

impact on available funds and available personnel, wouldn't it?

A. It has some impact and capital and OM&A tend to be treated somewhat differently. I think it would be unwise to draw, to try and explain this correlation as being due to one or two factors only. I think there were many things going on here at the same time, the retubing, the budget restraints, the concurrent commissioning at Pickering "B" and Bruce "B." There were many factors. It's quite a complex correlation, and I think it would be misleading just to sort of attribute it to one or two factors only.

Q. You also testified, Mr. Daly, that if OM&A expenditure changes were causing capacity factor changes, you would have expected to see a two-to-three year lag between increasing expenditures and increasing capacity factors. We don't see this at all, at least up until 1987, on this graph. So I put to you that increasing OM&A expenditures could, taking into account this time lag that you would expect to see, account for some of the increasing capacity factors after 1987 where the lag is apparent but not before. Would you accept that?

A. Well, I'm trying to find your increase in capacity factor after '87.

Q. Well, I have increasing expenditures after '87. The capacity factor comes back around '90. I guess my point is that before '87 we have a correlation in each year. That wouldn't account for any of the lag that you testified you would have expected to see.

A. Again, our models do indicate this lag. And we would expect that expenditures would not lead to improved performance until about two or three years ahead. What tends to complicate factors is the fact that this does not go on in isolation. If nothing else changed, that is our opinion as to what you would see. But other things were changing during this period, you know, particularly related to retubing.

So while we do expect, given a stable situation, that more dollars generally leads to better results, the other factors make the correlation a little bit more difficult to see.

MR. MONDROW: Could you turn to page 21 in our interrogatory package, please. This is Interrogatory 9.7.108, which needs a new exhibit number, please, Mr. Lucas.

THE REGISTRAR: .135.

MR. MONDROW: Thank you.

---EXHIBIT NO. 520.135: Interrogatory No. 9.7.108.

MR. MONDROW: Q. If you turn to figure 2, plotted in response to that interrogatory, which is at page 24 of our package, you see a dollars of the year trend plotted against the Consumer Price Index from 1974 to 1989.

Mr. Penn, the plot here from 1974 to 1989 corresponds with the plot at page 70 of your overheads, doesn't it? The scale is different but the plot is the same.

MR. PENN: A. Well, subject to check I would expect it should, yes.

Q. All right. Fair enough. And this graph, indeed, seems to indicate that you have not experienced OM&A increases significantly greater than the rate of inflation. You would agree with that?

A. I think you can say that through the period '74 to '86 or so, that's generally the case, yes.

Q. Then you started in '87, as you have testified, to significantly increase your OM&A expenditures to account for the backlog.

A. Yes.

Q. I would like to suggest to you an explanation for this apparent tracing of the CPI trend, if you will bear with me for a minute. In the

program's early years when Pickering was young and the others weren't yet operating, you wouldn't expect there to be much OM&A.

As we saw a few minutes ago in the Kinosian paper, it was suggested that OM&A was connected with aging, that aging wasn't an initiator of increasing OM&A costs. Would that make sense? In the early years of your program you wouldn't expect to see a whole lot of OM&A expenditures? The first plant was brand new.

A. Well, again, I think Mr. Daly may have to help me. But a considerable part of the OM&A cost is fixed. You have to refuel the reactors at a constant rate. You have to maintain all the necessary safety equipment and operating equipment. You have to have the security guards. You have to have the administration. So while there could be a trend upwards in time, I wouldn't think that it's a considerable difference in OM&A between the first two or three years, say, and following 10 years or following 20 years.

Q. If we look at the year -- Mr. Daly?

MR. DALY: A. No, I don't think I can add much to what Mr. Penn said. The staffing certainly were a significant part of the increase from '87 to

'89, but some of that was for additional purchased services which we realized we needed to assist with maintenance.

Q. If you look at the plot here from 1979 through to about 1983 or 1984, I guess it's 1983, you will see that the line seems to depart from the CPI index line. But that stops at about 1983 and drops back down. And that was about the time you started your capital modifications, isn't it? That was your budget restraining time.

A. That's correct, yes.

Q. And starting in 1987, as you have testified, you started to put a lot more money into OM&A. And you see a line -- just a minute, Mr. Penn. Let me finish my question.

So I would suggest to you that without the budget restraints and after the first few years of operation, if we, in fact, traced a line, it would significantly diverge from the Consumer Price Index plotted there. Would you accept that? You'd see a trend that outpaced Consumer Price Index trend.

A. I really don't think that curve has any meaning.

Q. Well, it means that your OM&A expenditures are climbing faster than inflation.

A. Yes, but that wasn't our experience. Our experience is as you see it here. And what you are giving me is a hypothetical.

Q. Well, in actuality you had budget constraints, and you have testified that because of those constraints you had a lot of backlog and now you have to deal with it. If you hadn't had the budget constraints, I put to you, your trend would have been greater than inflation all along. Do you accept that?

A. No. Not necessarily. I think I understand your point a little better now. I think certainly in those years, had we not had the restraint and certainly the OM&A would have been higher in, let's say, '84 and '85. But then we would have had the staff in place earlier and have been able to get work on the backlogs and catch up with maintenance earlier. And I think the effect of that would have been to start pulling it down towards the CPI. So we are in a sort of catch-up situation here. And I think had we had the staff in place earlier, we would have had a better chance of maintaining ourselves on the CPI.

Q. Could we look at page 70 of Exhibit 519, please?

[4:50 p.m.]

If we see starting at your forecast, this

assumes, I think, that you have everything under control, you started very gradual, at worst 1 per cent increase per year.

Now if you went to the point in 1983 where you had budget restraints marked and you drew a line up, a smooth line to where you will be at as soon as you get things settled down in the future, you would see a significantly different pattern there. It wouldn't go up as high as it actually did due to the backlogs, but I put to you that it would up faster than inflation as we saw in the previous graph. Will you accept that?

A. Well, again, it's a hypothetical line, and without -- to be able to plot that line you would have to say, okay, what additional funds might you have been given in those years and what might the dollars per kilowatt have been, and then what would have happened in subsequent years had you had those dollars. It's very hypothetical, difficult to deal with.

This is our actual experience. We have made a significant increase in recent years and we think that based on that very sizable increase, I think a significant part of our rationale for future stability is that we have made a very substantial

increase, almost a factor of two, over the last three or four years. We are now halfway through the plant life and we have a much better appreciation now of what is needed on an ongoing basis.

Q. Okay.

MR. PENN: A. The only other comment I would make, Mr. Mondrow, is that it is a well-known fact, I think it is well-known, that we went through a period of more than 10 years in the late 70s to the late 80s where the rate increase per annum for electricity charged to the average consumer added up to only being one per cent more than the rate of inflation during that whole period. So I think that is a good indicator of tracking the CPI.

Q. And that was in the face of the budget constraints that you faced in your maintenance costs, among other things.

A. Pardon?

Q. During those years when you just said you had a pretty good indication of tracking of CPI, your budgets were constrained. You testified to that.

A. They were during part of that time, part of that time.

The other comment I wanted to make is that the budget restraint in OM&A, OM&A is an expense

on an ongoing basis. It's not affected by the capital modifications which as I say are capitalized and then they are depreciated once the asset is placed in service, so the two aren't related.

Q. Is that true for rate-making as well?

A. For rate-making?

Q. Excuse me. Thank you.

An aspect of operations unique to nuclear would be the waste handling challenges, I think you would agree with that, Mr. Johansen. You don't have those technologies with other types of technology.

MR. JOHANSEN: A. I don't think I can agree with that as a general statement.

It's not unique. There are perhaps unique aspects of the waste which we have to manage. But there are many kinds of industrial wastes that pose formidable problems -- challenges, rather.

Q. For the permanent spent fuel disposal facility you are now charging both estimated capital and operating costs to customers, you are allocating it under fueling costs; right? Made a rate provision for that.

A. That's right. Mr. Penn has testified to that effect.

Q. Right. I found a figure of - I am

going to put this out for you - 6,542 million 1990 dollars for operating the permanent used fuel disposal facility.

First of all, I guess does that figure sound right, and, secondly, that figure then would be operations over all the years that you are filling up the facility?

THE CHAIRMAN: Is the Bruce one you are talking about?

MR. MONDROW: This is the permanent repository for used fuel, Mr. Chairman.

THE CHAIRMAN: The one that is coming in in 2025? Is that the one?

MR. MONDROW: Yes, hopefully.

MR. JOHANSEN: I really don't know where that number comes from. It doesn't ring a bell.

MR. MONDROW: Q. We could turn that up actually. I was going to turn it up later, but we can take a look at it now.

If we go to page 28 of our interrogatory package.

MR. JOHANSEN: A. Yes, I see it.

Q. This is Interrogatory 9.7.19.

I think, Mr. Lucas, we will need a number for this, please.

THE REGISTRAR: .136.

---EXHIBIT NO. 520.136: Interrogatory No. 9.7.19.

MR. MONDROW: Q. Actually, if you flip through, there is a one-page -- two-page, actually, separate response and then we get to a report starting at page 31 of our package. I will come back to this report, but just to give you some context for the figure, if you could turn to page 33 of the package. You will see a little table at bottom of the page, future used fuel management costs and you will see operating costs of $6,250 million, and the note says that is in 1989 dollars. I'm sorry, I misquoted that, I said 1990; it's actually 1989. Those costs then, it sounds like a lot of money to me. Those would be costs over the whole operation of that facility as you are loading it up, is that right, over all years?

MR. JOHANSEN: A. Well, Mr. Penn can probably add a comment but...

Q. You could check that for me if you are not certain.

A. Yes, I would feel more comfortable checking that.

This isn't an area that I have other than sort of incidental expertise.

Q. You are the person that I should ask

questions with respect to the used fuel disposal facility, Mr. Johansen?

A. Technical matters and environmental matters, yes. But cost is in the bailiwick of Mr. Penn.

Q. Mr. Penn, would you be able to tell me if that figure is for all of the years that the facility will operate?

MR. PENN: A. Yes. In my direct evidence I gave the figure, I think it was -- just let me look it up.

Q. If it's difficult we could back to it. If you have it handy, I can wait a few seconds.

A. No, I don't think it's difficult.

Well, subject to check, it's $1,275 per fuel bundle, and the figure that's now -- now that's in 1991 dollars.

Q. Right.

A. These figures in '89 dollars are, in my view, about right. And you are quite right that it would cost 6.25 billion by the time the facility is closed and contains 5 million bundles.

Q. Of course no one has ever operated such a facility; right?

A. No, I can't agree there. Sweden, for

example, is currently operating facilities.

Q. Permanent disposal?

A. Yes.

It's certainly true that in North America we haven't as yet got one operating. It may be that the United States will have it operating before Canada, at Yucca Mountain.

Q. The Swedish facility, is that a deep geological burial facility as well?

A. I am not very familiar with the details of it, unless Mr. Johansen does, but I wouldn't class it as a deep burial facility, no.

Q. They actually bury their fuel next to the reactor, right, in Sweden?

MR. JOHANSEN: A. They do at present.

Q. It's not a permanent disposal?

A. They have an underground repository for low and intermediate level waste.

Q. Not for used fuel?

A. Not for used fuel.

They have a demonstration or research facility for used fuel and they have plans for a deep geologic repository around about the year 2020, I believe it is.

Q. You don't have a plan for the

permanent disposal of non-fuel waste, you testified to that already, Mr. Johansen.

A. We have a plan but it's being updated

Q. It's quite out-of-date I think you testified.

A. It is quite out-of-date. The new plan is just around the corner.

MR. MONDROW: I think, Mr. Chairman, this might be - although it's a bit early - an appropriate time to take a break.

I should inform you of our timing, I guess. We will be back on Monday and I suspect we will go most, if not all, of the day on Monday. I am in touch with those who will follow and I am keeping them advised of our time estimate.

THE CHAIRMAN: But you will be finished some time on Monday.

MR. MONDROW: We will do our best, Mr. Chairman. Perhaps Monday morning I can give you a better indication. I will try.

THE CHAIRMAN: All right. We will adjourn until Monday then.

Next week we do not sit on, as you probably know on Thursday the 7th. We sit Monday, Tuesday, Wednesday only.

THE REGISTRAR: Please come to order.

This hearing will adjourn until Monday morning next at ten o'clock.

---Whereupon the hearing was adjourned at 5:00 p.m., to be reconvened on Monday, May 4, 1992, at 10:00 a.m.

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